SCIENCE

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THE BUDAPEST CONFERENCE OF THE INTERNATIONAL GEODETIC ASSOCIATION.

THIS account of the recent meeting of the International Geodetic Association is necessarily unbalanced and incomplete. It must be brief. The formal minutes of the meeting were not available for use while preparing the report. It is not easy for one to appreciate fully all that occurs in a meeting in which the proceedings are carried on in three languages. Nevertheless, it is believed that a prompt report, calling attention to some of the more important features of the meeting will be of value, even if the report has defects.

The Fifteenth General Conference of the International Geodetic Association was held at Budapest, September 20–28, 1906. Such conferences of the association are, in general, held at intervals of three years.

There were present 61 delegates, representing 18 nations. Nearly every part of Europe was represented, as well as Japan, Mexico, the United States and Argentina. Argentina was represented in the association for the first time at this meeting.

The United States was represented by the undersigned.

The activities of the conference may conveniently be grouped in four classes and such grouping is favorable to a clear understanding of the purpose and effect of the conference. The activities were: (1) The presentation by the representatives of the different countries of reports of the progress in geodetic operations during the

past three years in those countries; (2) the presentation of special papers bearing upon improvements in instruments, methods of observation and methods of computation; (3) the transaction of the business of the association itself at the conference, in connection with the continuous operation of the central bureau maintained at Potsdam and in connection with the field work being done by the association as an organization; and (4) the social features of the meeting.

Through this and similar conferences a close and effective cooperation of many men of many nations, acting as an association, is secured in a certain few lines of research. Of these the greatest now being carried forward is an investigation of the variation of latitude.

Aside from this cooperation, all the activities of the conference served to make it a clearing house for ideas, a place where each may learn what ideas, old or new, are being acted upon in geodetic work in other countries than his own. In this process the social functions play an important part in bringing men together and helping them really to understand each other.

The association, as such, does not fix the methods of observation or computation in any country. It controls only the methods used in its own central bureau and in the field work paid for from the association funds. But, by virtue of the active interchange of ideas which takes place at the conferences, the association undoubtedly exerts a strong influence in making the methods used in various countries much more uniform and progressive than they otherwise would be.

The reports of progress within the past three years which were submitted show that the rates of progress in accumulating new results are very different in different countries, depending upon a great variety of conditions. Each country brought some contribution and the total represents a rapid increase in the mass of geodetic facts available for future use. It would be tiresome to summarize these reports here and the summaries would be of little value. Three items are, however, of special interest. Progress has been made within the last three years in the observations and computations connected with an arc in Spitzbergen and in connection with the remeasurement of the classical Peruvian arc, extended. Progress has also been made in South Africa on the measurement of an arc which is expected, ultimately, to extend from the Cape of Good Hope to the northern part of Russia, a total length of 104°.

Let us turn now to the special papers bearing upon improvements in instruments, methods of observation and methods of computation.

Th. Albrecht, of Germany, presented a report on a thorough investigation made at and near Potsdam, of the applicability of wireless telegraphy to the accurate determination of differences of longitude. The transmission time was found to be extremely small and sensibly independent of the particular receiver used and of the intensity of the sending.

Though not a delegate to the conference, Ch. Ed. Guillaume, of the International Bureau of Weights and Measures, by special invitation occupied the greater part of one session in presenting the results of the many tests of the Invar (nickel-steel) wires made at the International Bureau, describing the apparatus devised there for the rapid measurement of bases with Invar wires, and in giving a general statement in regard to the use of this apparatus in the measurement of a base extending the entire length of the recently completed Simplon tunnel. The extensive investigations of the International Bureau

show that the changes in length to which the Invar wires are subject are so small, and that the Invar wires have such physical properties, that they are suitable for the measurement of primary bases. The experience in the Simplon tunnel confirms this conclusion. The base apparatus there used is elaborate in comparison with that now in use in the United States for the measurement of primary bases with steel and Invar tapes. It also differs radically from the Coast and Geodetic Survey (U. S.) apparatus in having the entire measurement carried forward on movable tripods, just as measurements with base bars are made, instead of being carried forward on stakes driven in the ground, as are the tape measurements in the United States. The Simplon tunnel base was 20 kilometers long. The tunnel was placed entirely at the disposition of the measuring party for five consecutive days, no trains being run during that time. The measurement was made continuously in each direction through the tunnel, the party working in shifts of eight hours, day and night. The forward measurement was made in 59 hours. The remeasurement was made, after a day of rest, in 27 hours. The total number of persons employed on the measurement at any one time was 28. Seventy-seven different persons in all were involved in the measurement. This performance and its results leave no doubt that the necessary accuracy can be secured more quickly and conveniently with Invar wires than with any bar apparatus. Any one who will carefully compare this work, in all respects, with what has been accomplished with steel and nickel-steel tapes in the United States, on primary base work, will also be convinced that all the advantages claimed for wires may also be claimed for tapes, and that the use of tapes, rather than of wires, and of stakes, rather than of tripods, makes the measurement much more rapid, economical and convenient, and that the tapes are more reliable, as to length, than the wires.

Baron Eötvös, of the University of Budapest, occupied the greater part of one session in presenting a discussion of the results secured by him with certain torsion balances of special design. A similar presentation may be found in *Wiedemann's Annalen*, 1896, and another in the report of the Congrès International de Physique, Paris, 1900. He evidently aroused much interest. The conference visited his laboratory in a body to see the apparatus. He derives from the observations the first differentials of gravity with respect to distance measured along the three rectangular axes at the point of observation. From these observed quantities may be derived various other quantities, such as, for example, the radii of curvature of the geoid at the point of observation. The claims made as to the simplicity of the manipulation of the apparatus, the accuracy of the results, and the certainty with which the positions of the excesses and defects of mass within the earth may be determined by such observations, are astonishing. If the validity of these claims is established by future investigations, these torsion balances will become very important as being the most powerful means available for determining the distribution of density within the earth.

Dr. O. Hecker exhibited the very interesting apparatus which has been used by him, under the direction of the association, for determining the value of gravity at sea. He presented the results of recent observations made with this apparatus on the Pacific on two voyages between Sidney, Australia, and San Francisco, and between San Francisco and Yokohama. The atmospheric pressure is determined in terms of millimeters of mercury by a mercurial

barometer and simultaneously the pressure is also determined in absolute units by an accurate observation of the boiling point of water, using mercurial thermometers. From these simultaneous observations the intensity of gravity at the point of observation is computed. This method is entirely successful in determining gravity with the accuracy necessary for an effective study of the anomalies in gravity. This is the only successful method yet devised for determining gravity at sea with sufficient accuracy. Such observations are of extreme importance to geodesy, because they are the only geodetic measurements possible over three fourths of the globe. Hecker's observations show that, in general, over the deep Pacific gravity has nearly its normal value, as computed by Helmert's formula of 1901, fixing the relation between gravity and latitude. Parenthetically, it may be remarked that this indicates that the condition called isostasy exists. Four regions with large anomalies, with reference to Helmert's formula, were found. Near Oahu, one of the Sandwich Islands, gravity is considerably in excess at sea, just as it has already been observed to be on the island. There is a region of excessive gravity in shallow water near New Zealand. Over the submerged Tonga plateau, where the depth is 3,000 meters, gravity is largely in excess and in the adjacent Tonga deep (5,000–10,000 meters) there is a large defect of gravity.

H. Kimura, of Japan, reported on a harmonic analysis of the variation of latitude which has been made by him. The analysis develops the very interesting fact that in addition to its other motions, already approximately known, the pole has a reciprocating motion approximately along a straight line, with a period of about 0.75 year, a period which is not commensurable with any of the other known periods of the polar motion.

Lallemand, of France, for many years the authority on precise leveling, stated that a series of experimental comparisons had been made in France between the French instrument and method and the instrument and method used in the U. S. Coast and Geodetic Survey since 1900. The conclusion reached was that the degree of accuracy is sensibly the same in the two cases, because in each the instrumental errors have been made so small that the errors in the results are mainly due to meteorological conditions, that is to conditions between the object glass and the rod.

On the part of our own country there was presented a special report upon a recent determination of the figure of the earth, made by the Coast and Geodetic Survey and based entirely upon deflections of the vertical observed in the United States. This report showed that to secure the highest degree of accuracy in such determinations the theory of isostasy must be taken into account; that the United States is not maintained in its position above sea level by the rigidity of the earth but is, in the main, buoyed up, floated, because it is composed of material of deficient density; and that the defect of density is limited to the depth of 71 miles, if it is uniformly distributed with respect to depth. This report, if it is convincing, must ultimately produce radical changes in the methods of computation used by geodesists. It also has a direct bearing upon several of the greater problems of geology and of geo-physics.

The activity of the association itself, as distinguished from the activities represented by reports of progress and special papers, is indicated by the fact that the average rate of expenditure for the past three years has been $19,000 per annum. This covers administration, printing and postage, the maintenance of the central

bureau and such field work as is paid for by the association.

The principal work of the central bureau, under the direction of Dr. F. R. Helmert, may be summarized as follows:

Relative gravity determinations in various countries have been furthered by special examinations in detail of apparatus to be used for this purpose and by instructing the observers.

Professor Borrass has been occupied in studying the existing relative gravity determinations with a view to their proper combination in a gravity net extending over the globe.

A systematic study of deviations of the vertical in Europe has been continued by Professor Börsch, and progress has been made in the publication of the results.

A systematic study by Dr. Helmert of the curvature of the geoid along certain meridians and parallels, in countries where there is extended triangulation, has been nearly completed.

The determination by Dr. Kühnen and Dr. Furtwängler of the absolute value of gravity at Potsdam which has been in progress for several years has been completed and the final results are now being printed. In these determinations, five different pendulums have been used at Potsdam and a very extensive series of observations have been made with great care. It was found that the general experience of the past was repeated and that systematic differences, much too large to be accounted for as errors of observation, were found between the results from different pendulums. In trying to account for the large residual furnished by one of the five pendulums, which was of peculiar form, the suspicion arose that possibly the stem of this pendulum was subject to flexure, as the pendulum took various positions during each swing. Accordingly, a mathematical theory of such a possible flexure was developed fully for the first time. The effect of the flexure upon the value of gravity given by each of the five pendulums was then computed, using this mathematical theory which expresses the effect in terms of the modulus of elasticity of the material composing the stem, the dimensions of the stem, and the masses of different portions of the pendulum. The corrections brought the results into closer agreement. The same theory was, with similar success, applied to six other series of pendulum observations made at various times and at places connected with Potsdam by accurate relative determinations of gravity. In these series, pendulums of various designs have been used. The adopted value of gravity at Potsdam is a simple mean of the seven values, one of these being the value observed at Potsdam. The adopted mean differs by one part in 25,000 from the Potsdam determination. Helmert states that he believes the possible error of the adopted mean to be less than one part in 100,000. The total range of the seven values is one part in 33,000.

Two of the seven values depend upon observations made with the Bessel ball and wire pendulums. For these the complete theory developed by Bessel for taking account of the flexure of the wire was used without modification.

The gravity determinations at sea by Dr. Hecker, already referred to, were made under the direction of the central bureau and paid for by the association.

The principal field work, supported by the association, is the determination of the latitude variation. For the latitude observations and the necessary computations of them, made at the central bureau, the expenditure has been, on an average, $14,000 per year, during the past three years, more than two thirds of the total expenditure of the association. From 1899 to date, observations have been made continuously at

six stations, all in latitude 39° 08′ north, and surrounding the pole. In 1906, two stations in the southern hemisphere were established, in Argentina and in Australia. The observations at all of these eight stations will be continued at least until 1909. The accuracy with which the motion of the pole is followed by these observations may be inferred from the fact that Kimura writes with confidence that the movement having a period of 0.75 year exists, though its total amplitude is apparently 0.06″ (6 feet) or less.

By a formal resolution, transmitted to it in advance of this meeting, the association was asked by the International Association of Academies in what way it could sustain or promote international cooperation in the following two matters: (*A*) Leveling of precision in chains of mountains subject to earthquake, with a view of determining whether such chains are subject to changes in elevation; (*B*) measurements of the value of gravity for the purpose of throwing light upon the internal distribution of terrestrial masses and upon the rigidity or isostasy of the crust of the earth. This resolution is the result of action taken at the International Geological Congress, held in Vienna in 1903.

A special report on that part of the resolution which refers to leveling was, by request, prepared in advance by Lallemand of France. He set forth the rather discouraging past experience in this line and indicated the essential difficulties of the problem. He reported that determinations of the stability of the ground by means of precise leveling, repeated at long intervals, should be made in all regions, not simply in chains of mountains subject to earthquakes; that ordinarily a general change of elevation of less than one decimeter can not be detected with certainty; and that each country should repeat the leveling, over at least the principal lines of its precise level net, two or three times in each century.

Darwin, of England, prepared in advance, by request, a report on that portion of the resolution which refers to gravity determinations. He suggested a resolution in reply to the effect that the association welcomes the resolution transmitted to it as showing that geodetic observations throw light on the science of geology, and that the association further desires to impress on geodesists who may be planning future gravity observations that it is desirable that the sites for observation should be chosen with reference to such use of the observations.

The recommendations made by Messrs. Lallemand and Darwin were incorporated in a resolution passed by the association. At the suggestion of Darwin the resolution, as passed, also definitely recognized that observations of the direction of gravity, that is of deflections of the vertical, may also be used in determining the isostasy or rigidity of the crust of the earth, as well as observations of the intensity of gravity.

Nearly all of the party lived at the same hotel. Numerous social functions also kept the party together and served to make the delegates acquainted with each other. Among the social functions were a reception by the Archduke Josef, at the Royal Palace, a dinner given by the city of Budapest, a dinner given by Count Apponyi, the Minister of Public Instruction, an informal dinner given by the delegates in honor of their entertainers, an evening of Hungarian opera and several afternoon excursions.

The surroundings in which the conference met were especially interesting. It is a surprise to find that Budapest, the Hungarian capital, is a rapidly growing modern city, with all modern improve-

ments. One finds in it an intense national life and, at the same time, many interesting evidences of the influence of several different civilizations. Eleven different languages are officially recognized by being printed upon the paper money.

O. H. TITTMANN,
JOHN F. HAYFORD.

SCIENTIFIC BOOKS.

Mars and its Mystery. By EDWARD L. MORSE. Boston, Little, Brown and Company. 8vo. Pp. 192.

This book is distinctly a plea for the existence of intelligent inhabitants upon our sister planet, the argument being based largely on the observations of Professor Lowell at Flagstaff, Arizona. The author begins by pointing out that because a man is an astronomer, this fact by no means qualifies him to act as a judge upon a question of this sort. It is doubtless true that astronomers as a rule know little of the appearance of the surface of Mars, and but few of them have ever seen it under favorable conditions. Nevertheless, it must be admitted that a man who is familiar with the difficulties of telescopic observations, under varying atmospheric conditions, would be a better judge of the value of telescopic evidence than one who had never looked through a telescope, and took it for granted that the planet looked exactly as it is drawn on paper.

A large part of the book is devoted to an examination of the views of various astronomers and amateurs as to the interpretation of the various markings seen upon the planet's surface. The book is marred in one or two places by a rather savage personal attack upon a British astronomer in good standing, partly, apparently, on account of his religious convictions! Considerable attention is paid to the appearance of various systems of natural cracks, such as appear in pottery, dried mud, and the surface of the moon. Two interesting plates are given, in which these are compared with maps of railway systems, canals, and the markings upon Mars. The argument is drawn that the last look, and are distributed, much more like the artificial than like the natural lines. Whether such is the case or not, the critic will be likely to ask "But would the markings on Mars, if we could see them well, really resemble the drawings that Professor Morse publishes of them?" This is the very *crux* of the whole question, and until this has been definitely decided, most astronomers will consider the existence there of intelligent inhabitants as unproved, although perhaps not impossible.

The main and generally accepted facts relating to the planet's surface are briefly stated, and are followed by an interesting and rather amusing account of the author's own difficulties in seeing even the well-known and most clearly defined markings of the planet. He certainly had much more difficulty than would have been expected, considering the careful training of his eye in his own professional work.

One of the most interesting chapters of the book is that devoted to the discussion of the variety of conditions under which life exists upon the earth. Here our author is more nearly on his own ground, and states a number of interesting facts, many of which it is safe to say will be new to the majority of his readers. From them he argues that the slightly dissimilar physical conditions that exist upon Mars would not interfere with the existence there of life in some of its various forms, such as we know it upon the earth.

In closing, it may be said that the book is interesting, and well worth reading to all those who wish to learn the opinions of various authorities on the most fascinating of all the planets.

WILLIAM H. PICKERING.
HARVARD COLLEGE OBSERVATORY.

First Course in Zoology. A text-book for secondary schools, normal schools and colleges. By THOMAS WALTON GALLOWAY, Ph.D., Professor of Biology in James Millikin University. P. Blakiston's Son and Company.

This book adds another to the list of text-books in zoology, of an elementary nature, which have appeared within the past half dozen years, and is indicative of the growth

of interest in the subject among educators. Unlike most of this number, the present book purports to be adapted to either secondary school, normal school or college grade. In one respect this is a point worthy of consideration, in that it seems to recognize the correct pedagogical principle of the essentially similar aims and methods of the elementary course, whether in school or in college. On the other hand, it involves the difficult problem of furnishing a course of instruction, suited in character and extent to students of the varying capacity and training of the second or third year of the high school and the corresponding second or third year of the normal school or college, the periods in which such course is likely to have its place. The task is not, perhaps, impossible, but confessedly difficult; and to the reviewer's thought the present book has not clearly solved the problem.

For the average school course the book includes too much, and too difficult work; while for the college course it seems to fall as far short. For the normal school, and this is probably the grade of work more directly aimed at by the author, the book would seem to be well suited.

In method of arrangement the book follows rather closely the well-known 'Lehrbuch der Zoologie' of Hertwig, best known to American teachers of zoology through Kingsley's translation under the title 'Manual of Zoology.' That is, there are two parts to the book. (I.) General Principles; (II.) Special Zoology. Under the first part is a series of chapters dealing with protoplasm, the cell, the tissues, physiology, adaptation, etc. Under the second part is taken up a review of the entire animal kingdom, from protozoa to mammals. That there are elements of value in this method of presentation will not be questioned. That they are of the fundamental and supreme importance assumed by their authors is not so clear. To the writer the method has always seemed open to serious objections. For example, to begin such a course with the study of the morphology and physiology of protoplasm, followed by an attempt to clear up the intricacies of cell morphology, including the details of cleavage, chromosomes, centrosomes, spiremes, with prophase, metaphase, etc. (cf. pp. 22–35), reverses one of the fundamental canons of sound pedagogy, long since pointed out by Huxley, and now generally recognized by most teachers of zoology.

A similar criticism holds with reference to the chapters devoted to tissues, promorphology, and adaptations. To formulate these points in advance, outline the problems of evolution, etc., and rally about them the various data involved in their solution, is again to reverse the inductive order, presenting first that which ought to form the climax and conclusion of the course, thus depriving the student of the privilege of coordinating the facts as they develop. The chapters on general animal functions and something of tissues are, perhaps, very appropriate, though it has always been the method of the reviewer to develop these points as they arise in the progress of the course. And to devote fully one third of the entire book to such a preliminary study seems altogether disproportionate. Indeed, this course seems to include something of two ideals, namely, *biology* as distinguished from *zoology*, or in other words including two courses under a single caption.

In another respect the book is open to some criticism. The author postulates for the elementary course in zoology a four-fold purpose, viz., '(1) laboratory work, chiefly physiological, and in the larger problems of morphology rather than in minute dissection; (2) to field observation on physiology, life histories, the simpler problems of distribution and life relations; (3) to the body of the descriptive text, and (4) to classes of questions demanding reference to classical zoological authorities.' To each of these phases he would give an equal apportionment of time. It may be doubted whether for elementary pupils this would not prove impracticable, especially reference to such 'classical authorities' as Darwin, Wallace, Davenport's 'Experimental Morphology,' Lloyd Morgan's 'Animal Life,' Eimer's 'Evolution,' etc.

Of actual errors in statement of facts or principles there seem to be relatively few. In speaking of the larval life of echinoderms the author refers to them as 'free-swimming—

pelagic—' etc., seeming to use the terms as synonymous. Again, there is something of doubt in the validity of certain references to symbiotic relations, as in the following: '*Hydractinia* and even the sea-anemone form interesting partnerships with the hermit-crab.' This is all admirable and beyond dispute. But that 'the polyps cover up the shell occupied by the crab, thus concealing it from its enemies and its prey' may be seriously doubted. Indeed, every observer knows that there are more hermit-crabs without the hydroid colonies than with them. And furthermore, the reviewer has found larger colonies of this particular hydroid on bits of water-logged spars and on the piles of a dock than the combined colonies of scores of crab-shells.

The figures are for the most part well selected and executed. In a few cases figures are rather too diagrammatic for accuracy. In its mechanical aspects the book is a creditable piece of press-work. The typography is excellent and mistakes few. A slight one may be noted in the description of Fig. 68, where the expanded and contracted vorticellæ are wrongly indexed. C. W. H.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for October contains but two papers: 'The Naididæ of Cedar Point,' by L. B. Walton, and the 'Mechanism of the Odontophoral Apparatus in *Sycotopus canaliculatus*,' by J. C. Herrick. The microscopic Oligochæta have received little attention in this country and Professor Watson's paper deals with the local species systematically, giving a key to the genera and describing seven new species. Professor Herrick describes in detail the structure and workings of the rasping apparatus by means of which the winkle bores through and destroys so many clams and similar mollusks. He decides that Huxley's views were correct and that the radular membrane bearing the teeth slides back and forth over the supporting cartilage like a chainsaw.

The Bulletin of the College of Charleston Museum for October is mostly devoted to the early history of the museum which may possibly claim to be the oldest public museum of natural history in the United States. The rival claimant is the collection of minerals of Harvard which dates back to 1798.

The Museum News of the Brooklyn Institute for November has articles on the 'Housekeeping of a Large Museum,' 'The King Penguin' and on 'The Woodward Jade Collection.' This last contains a good *résumé* on the history of jade objects and the methods of working. The principal article in the Children's Museum section is devoted to 'Bird Life in Bedford Park.'

SOCIETIES AND ACADEMIES.

THE TORREY BOTANICAL CLUB.

ON May 23, 1906, the club held a special meeting in commemoration of the tenth anniversary of the commencement of work in the development of the New York Botanical Garden.

The meeting was held in the lecture hall of the Museum Building at the Botanical Garden. President Rusby presided, and there was an attendance of 125. The following persons were elected to membership: Percy L. Ricker, U. S. Department of Agriculture, Washington, D. C.; Miss Winifred J. Robinson, Vassar College, Poughkeepsie, N. Y.; Miss Bina Seymour, 115 West 84th Street, New York City.

After the election of new members the club listened to an illustrated lecture by its president on 'The History of Botany in New York City.'

Dr. Rusby presented a historical sketch of the development of botany in the city of New York, giving special attention to the history of local botanical gardens, of the botanical department of Columbia College and of the Torrey Botanical Club. The earliest local work related to the botanical gardens of Colden, Michaux and Hosack, and to the publication of local catalogues and floras. The second period was that of text-books, manuals and other educational works. Out of the associations resulting from local work, the Torrey Botanical Club developed so gradually that it was impossible to fix the date of its

actual beginning. Portraits of its early members were exhibited and brief biographical sketches presented. Out of the activity of the club and of the botanical department of Columbia, grew the demand for a great botanical garden, which was satisfied by the establishment of the present New York Botanical Garden. The contemporary botanical forces at work in the city were briefly described, and their most important present needs outlined. The complete address was published in *Torreya* for June and July, and separates will be furnished at ten cents each.

The lecture was followed by an informal reception in the library, and by an inspection of the library, laboratories, herbaria and the museum exhibits.

C. Stuart Gager,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE POLICY OF THE U. S. GEOLOGICAL SURVEY AND ITS BEARING UPON SCIENCE AND EDUCATION.

To the Editor of Science: It is but fair to Director Walcott that his reply to my letter insisting upon my resignation should be laid before those who have seen the earlier letters. The following is a copy of it:

U. S. Geological Survey,
Washington, D. C., Nov. 9, 1906.

Dr. J. C. Branner,
Stanford University, California.

Dear Sir: Your letter of October 13 was received at this office on October 22, and in my absence was acknowledged by Dr. Hayes on October 23. I was naturally surprised on my return to find that this letter, together with other correspondence on the subject of surveys in the Arkansas coal field, had been published in Science on October 26. I am at a loss to understand your reasons for publishing the correspondence, inasmuch as I do not think anything is to be gained by a public controversy. I have sent a brief communication to Science (copy enclosed) explaining the principles which govern the United States Geological Survey in its relations with other geological surveys and working geologists.

In your letter, on page 2, you state seven reasons, deduced from my letter of March 8, for the course followed in this matter, and reply to them. Permit me to add a word of comment to your replies.

1. "The field work on the Arkansas coal region was done 18 years ago." You recognize that work done so long ago needs to be brought up to date before publication. Your contention is that, "having originated and directed the survey of the Arkansas coal fields," you should be allowed to bring the work and the report up to date. This, of course, is the gist of the whole matter, and I shall revert to it again.

2. "It was based upon poor maps." There is no difference of opinion on this point. Inasmuch, however, as the scale of publication proposed by this Survey is only half that insisted upon by yourself, and as the map will be published without contours, the defects in the topographic base are very much less serious than they would have been if your proposition had been accepted and an attempt had been made to publish maps on the 62,500 scale.

3. "The work is not 'up to present standards' and therefore could not be accepted for publication by the Survey." You state that "neither you nor any of your assistants have read the report and you can not therefore know anything about its relations to standards of any kind." While the report has not been read, you will recall that the maps were examined in December, 1901, by Dr. Hayes in connection with the proposition to publish the report at that time. These maps bore such evidence of inaccuracy and generalization that the scale proposed for their publication was not regarded as suitable and the recommendation was made that they should be reduced, preferably to one-quarter, and at least to one-half, the scale proposed. He made no statement regarding the standard of the written report, but considered the maps as amply justifying the statements made regarding the character of the work. You will recall that in the correspondence of 1901, when the proposition to publish your report was being considered, an essential condition to such publication was that additional field work should

be done by some member of this survey, Messrs. Taff and Adams being mentioned in this connection. You are mistaken, therefore, in supposing that there was any intention on the part of this survey to accept your report without thorough examination and additional field work.

4. "New uses for the coals have been found by the fuel testing plant of the survey." This has little bearing on the subject except that it increases the urgency for information regarding this coal field.

5. "Losses have been caused by errors in the map of the Arkansas coal field for which I am responsible." This is based upon very definite and emphatic statements made by large coal operators in the Arkansas field. They have stated that on the basis of the map published in the twenty-second annual extensive holdings were transferred from one region to another and on testing it was discovered that productive had been exchanged for unproductive territory. It was on account of the representations of these coal operators, and their urgent requests, that the work was undertaken in Arkansas, and not through the recommendation of any member of Congress.

6. "The salaries of regular assistants of the survey being provided for, work must be given them." Three geologists whose salaries had been provided for to the end of the year had completed their office work and were available for field assignment. If the money asked for the payment of yourself and assistants for the Arkansas work had been allotted, it would have been impossible to send these men into the field and they would practically have remained idle until the new appropriations became available.

7. You say "I was anxious to obtain your unpublished data, for which ample payment would have been made and full credit given." In reply to this you say "the reports of the Arkansas Geological Survey not being my personal property, I leave others to characterize your proposition to pay me for one of them." You imply in this statement that something dishonorable was contemplated in the transaction. I must remind you that on July 9, 1901, a check for $200 was sent to you in payment for a report on the clays of Arkansas, which presumably was as much the property of the state as the coal report. It was distinctly stated at that time that this payment was "for the necessary office work required to put your reports into shape for publication." The "adequate payment" for your coal report would have been for precisely the same purpose. If you had felt that you were not entitled to the payment, it would have been a simple matter to turn it over to the state of Arkansas.

As distinctly stated, I desired to obtain your report in order, first, that the results of your work might not be entirely wasted, and, second, that you might receive the credit to which you would have been justly entitled. However inadequate a report on the geology of a region may be, and whatever errors it may contain, it is of some benefit to another geologist who is taking up the study of the region, and I considered that a reasonable expenditure would be justified because of the benefit your report would be to a geologist entering the field.

I am quite willing to accept your statement of the seven reasons for my action which you have deduced from my letter of March 8. These reasons are all good and were regarded as fully justifying the course pursued. You are correct further in your conclusion that there are other reasons which it was not considered necessary to state in my former letters. In that correspondence I ought, perhaps, to have been less careful of your feelings. The additional reasons which had weight in the matter are as follows:

1. It was extremely desirable that the report on the Arkansas coal field should be issued at the earliest date possible. This was made a point of special urgency in the requests received from those most directly interested in the field. In order to secure this result it was deemed essential that the work should be done by regular members of the survey, who should bring their results to Washington and work them up here. I need only refer to the experience of the survey with your own reports to indicate the grounds for fearing that if the work were turned over to you prompt-

ness in publication would be impossible. The clay report above mentioned was paid for on July 9, 1901. The manuscript was received, after several urgent requests, at the end of March, 1904. The manuscript for the Santa Cruz folio was promised for July, 1903. It was received March 17, 1906.

2. An examination of your preliminary coal report published by the Arkansas Survey, together with the map furnished Mr. Taff for publication in the Twenty-second Annual, in the light of subsequent work on the coal measures in the region immediately adjacent in Indian Territory, led the geologists familiar with the matter to the conclusion that you had made serious errors in correlation and in the interpretation of structure in the Arkansas field. It was believed that these errors might very easily be perpetuated if the resurvey of the field should be made by yourself—that you would be handicapped by your belief in the correctness of your former conclusions, and hence that better results would be secured if the work were done by some one entirely free from preconceptions as to stratigraphy and structure.

3. During the last ten years much attention has been paid by this survey to the examination of coal fields in various parts of the country. A body of experts has been developed whose experience is probably not anywhere surpassed. On the other hand, so far as I am aware, you have, since leaving Arkansas, devoted little if any attention to the investigation of coal fields; also those whom you would probably secure for assistants in the work, with the possible exception of Dr. Newsom, would have had little if any experience in this kind of work. In this age of specialization it will, I think be conceded by all that even the examination of a coal field can be done more efficiently by coal experts than by those whose training has been in other lines of geology.

Concerning the last three pages of your letter I shall make very brief comment. The relations of this survey with existing state surveys are uniformly cordial. Every effort is made to strengthen state surveys and to cooperate with them in such a way as to render their usually limited resources most productive of good to the people of the state. Cooperation is never forced upon a state organization, and extreme care is exercised to prevent duplication by this survey of any work being carried on by any state organization. As to the invasion of fields occupied by professors of geology, there are in the files of the survey many letters to such professors urging them to work up the local geology and offering financial assistance and means of publication of their results. The case of the Fayetteville quadrangle is perhaps an apparent exception. It should be stated, however, that when the work was undertaken there Professor Purdue was practically unknown as a geologist and was, as a matter of fact, not sufficiently experienced to carry on independent work. Since his season with Adams he has been employed each summer and has submitted three folios for publication. It has been necessary, however, in connection with this work, to send more experienced men into the field with him, although he will receive the entire credit for the work.

The right of any geologist to restrict the field of operations of this survey in opposition to the public interests can not be admitted. Where work is being done by a private geologist or an institution or an organization, or where the work has been done, and there is prospect that the results will be published, it is manifestly contrary to good policy for another organization to enter the field and do the same work over again. The survey has scrupulously refrained from such invasion of an already occupied field. The fact that a field has been occupied does not, however, give exclusive rights to the first occupant indefinitely if there is no prospect that the results will ever be published. Eighteen years is sufficient time in which to secure publication of results, and in this case the interests of the public far outweigh any private interests you may have retained in the field.

Your letter of February 26, 1906, tendering your resignation as geologist in the United States Geological Survey has been forwarded

to the Secretary of the Interior with recommendation that the same be accepted.

Very respectfully,
CHAS. D. WALCOTT,
Director.

Some of the points mentioned in this and in the letter to the editor of SCIENCE, especially those relating to maps, scales, qualifications, errors both topographic and geologic, may be left to one side as being of little importance in this connection, though I should not hesitate for a moment to submit my own case on every count mentioned to any jury of scientific men. It is quite evident to any unbiased geologist that the reasons put forward for the survey's invading my field are mere subterfuges for an inexcusable course of conduct.

It is worth while, however, to note certain points in passing. Mr. Walcott does 'not think anything is to be gained by a public controversy.' Perhaps not; but it is certain that nothing is to be gained by an appeal to courtesy or by a private controversy with a public bureau that has the whip-hand of every working geologist in this country. And neither is anything to be gained by a cringing submission to such a bureau. This is a matter of public concern, and so long as one gets no hearing in private he has no remedy but to bring the subject to the attention of the public.

To the charge of making mistakes my reply is that I have made them and do make them.

Mr. Walcott says: "It appears from Dr. Branner's latest letter that he still regards the survey of a coal field worth many millions of dollars and capable of serving several millions of people as his own personal affair. This bureau is directed on broader lines." This is merely a bit of political dust, and the broad lines on which he directs the survey do not appear to preclude the use of such materials. I regard the work on the area concerned as my own personal affair just so far as the work done on it entitled me to finish it and no further.

Leaving these minor matters, attention is asked to four propositions that vitally concern scientific work and scientific education in this country as affected by the attitude of the U. S. Geological Survey toward state surveys and towards the geologists of the country not regularly employed on the survey.

First, it is maintained that the U. S. Geological Survey can and does encroach upon fields that, by the rules of equity and common courtesy, belong to state surveys and to local individual workers in geology.

Mr. Walcott meets the first proposition squarely in his letter to me. The italics are mine. He says: "*The relations of this survey with existing state surveys are uniformly cordial. * * * Cooperation is never forced upon a state organization, and extreme care is exercised to prevent duplication by this survey of any work being carried on by any state organization.*" Near the end of his letter to me he says: "*The survey has scrupulously refrained from such invasion of an already occupied field.*"

My own experience as state geologist of Arkansas is far from bearing out these statements; but as the survey of which I had charge is no longer in existence, and as he seems to wish to confine the question to those that have not yet been killed, let us take one that has managed to survive. One of the state geologists writes me under date of October 29, 1906, as follows: "*My own experience officially has been as bitter and wholly unjustifiable as yours.* By repeated and vigorous personal appeal * * * and only by resort to * * * our representatives in congress have I been able to save this * * * state survey from a most humiliating exigency. Indeed I have not wholly succeeded, and am grimly conscious to-day that though I have dislodged the U. S. Geological Survey corps from most all parts of the state, *its representatives have held on to one region where we were busily engaged at the time of their arrival, and ignoring entirely all our work, have carried their humiliating procedure to a finish.* We have spent some thousands of dollars in correcting the unskilful and erroneous work of these gentry. * * * To tell our experience would be a long story, perhaps bootless to rehearse, but I join with you and many others

in deprecating the present policy of the survey in the matter of intrusion upon states to the great discredit of the state organizations and the individual geologists."

And this Mr. Walcott calls 'uniformly cordial' relations, 'strengthening and cooperating with the state surveys,' and 'scrupulously refraining from invasion of an already occupied field'!

But whether the relations of the state surveys to the national survey are cordial or not (and I am far from doubting that *some of the state surveys know that unless they keep up the appearance of cordiality they will soon cease to exist*), I assert, without the slightest fear of successful contradiction, that there is not a single state geologist in this country to-day who does not know that his work, his field of operations, his livelihood, and his very reputation are wholly at the mercy of the national survey. And I ask any person who has the blood of a free man in his veins if this is not an intolerable state of affairs.

Mr. Walcott says that 'cooperation is never forced' on a state survey. I beg to refresh his memory with the fact that when a bill providing for a state geological survey was lately before a certain state legislature, he himself wrote to prominent members of the legislature advising that unless cooperation with the U. S. Geological Survey was provided for, the bill should not pass. If that is not forcing cooperation on a state then I fail to understand the English language.

So far as individuals are concerned the survey seldom takes them into consideration save when they do something or turn up something that is likely to serve the purposes of the survey. If the individual undertakes any special bit of work, whether in field or laboratory, the survey is in position to invade his territory, to drive him out of it, and to discredit him. Is it not a most humiliating fact that scientific men, in this the twentieth century, should be compelled by a federal bureau to hide themselves like whipped curs to gnaw their small bones in obscure corners? For if an investigator does not keep quiet about his work he knows perfectly well that, upon one pretext or another, he is likely to be pounced down upon and his work taken out of his hands—and 'due credit given,' of course! It is all very well for the director of the survey to say that he had no intention of doing such things. He has the power to do them and he does them.

The second proposition is that the national survey has discredited and enfeebled the state surveys, and that it prevents their normal growth even when it does not entirely drive them out of existence.

The truth of this statement is so self-evident that it hardly admits of discussion. The cases quoted above are proof enough, and instances more or less similar can be found in almost every state where state surveys still exist, and in other states where the surveys have been killed off through the influence, direct or indirect, of the national survey. This is the more important because the state surveys are vastly more useful to the states and to state industries than is the national survey. The state surveys, however small they may be, are in touch with the people, keep alive an active local interest in geology, and serve as a valuable training school for young geologists. And this widespread interest in science is not only important, but above all is it important that the people of this country be left to manage their own home affairs even though they may not manage them so well, rather than to have them directed by a bureau at Washington, run as a great scientific trust and paid for at the rate of millions of dollars a year out of the public funds.

It is no part of the functions of a national government to interfere with and to discredit state and other local governments, and just as little should it be a function of any national scientific bureau to weaken, patronize, or in any way discredit state and other local scientific work.

The third proposition is that a systematic effort is being made by the present director to deprive university professors of the support of the national survey to carry on work that falls or should fall naturally to them.

It is a matter of common knowledge that many of the professors of geology over the

country have received from the U. S. Geological Survey small allotments of money that enabled them to spend their holidays and odd hours in doing geologic work in which they were especially interested. This work has yielded excellent and far-reaching results both for the national survey and locally. It has greatly encouraged the younger geologists, for it has generally been regarded as a sort of official recognition of their professional ability and standing, it has enabled them to widen their knowledge and experience, and not infrequently it has enabled the poorly-paid teachers to keep their heads above water financially. This policy has justly strengthened the survey throughout the country. The survey seems to feel, however, that it has now outgrown the necessity of this kind of support, and the time has come when these professors are to be dropped as rapidly as it can be done without precipitating matters. The director probably realizes at the same time that, as long as the names of these professors are on the payroll of the survey, they are not going to quarrel with their bread and butter. The professors must face the situation whether they wish to do so or not, for here is the policy set down in black and white:

Mr. Walcott says in his letter given above that the professors "can not work as efficiently for the national survey as can the geologists constantly in its employ, and recognition of this fact has led in recent years to a reduction of the proportional amount of work allotted to teachers of geology, who can give but a share of their time to it." This statement of the case is straightforward and the question is well defined. Even if it were not so clearly put, the course of the survey during several years past made this plan apparent. Mr. Walcott's policy has lately made itself quite apparent also in the conduct of the Carnegie Institution of which he was for several years the secretary, and of whose executive committee he is still a member.

This plan on the face of it seems reasonable. It is to be noted that there is no complaint of the grade or character of the work done by the professors, it is simply that they can not give their entire time to it, and that they are therefore and necessarily slow in handing in results.

The fourth proposition is that such a system of discrimination by a national bureau against the scientific work of university professors discredits scientific instruction in the universities, and must inevitably react against the men who devote themselves to scientific work and study, against the dignity and usefulness of the teacher's vocation, against the high character and efficiency of scientific instruction in our institutions of learning, and eventually against science itself.

Science in this country has come chiefly from the educational institutions. It is in them that standards are set and maintained, and it is from them that the most incisive scientific thought has come. If the professors have been slow, they have also been painstaking and trustworthy. They have worked at science because they loved it, and their deep interest in their work and their unselfish and often fatal devotion to it has been a constant inspiration to their students, and a source of strength to the institutions with which they have been connected. Unfortunately, these professors have small salaries and they have little or no money with which to carry on their researches or original work, and even the little they have often comes out of their own slender private funds. There is another reason for this slowness of the professor that is not likely to appeal to the director of the survey: I refer to the fact that the amount of money allotted to the work to be done by a professor in the survey's employ is sometimes so small that he is unable to finish a given piece of work within a specified time and to do it as he thinks it should be done. In his letter of November 9 my own case is cited in evidence of the delay of the professors in handing in their results. The allotments made for the work mentioned (the Santa Cruz quadrangle) were so small that in order to do the work properly I was obliged to spend about a thousand dollars of my own money. Dr. Newsom, who joined me in this work, likewise paid out about seven hundred dollars to help put the work in better shape. Dr. Newsom's bill was finally presented to the survey and

was paid; I have never asked for reimbursement. This case is not mentioned for the purpose of excusing my own delay, but as affording an explanation of why university professors are sometimes slow, and to suggest at the same time that slowness may not be quite as bad as haste when that haste brings forth slip-shod results.

Here again the slowness of the professors is liable at any moment to be made an excuse for invading our fields of operations. Thus the whole tendency of the survey's policy of haste is towards more haste and poorer work.

I acquit Mr. Walcott of any intention to discredit professors by his policy. With his intentions, however, we have nothing to do; it is with his methods and results that we are concerned. We can not discredit the source of instruction and keep the instruction efficient. This wholesale discrimination against the universities can have no other results than those mentioned: discredit to the professors, eventual loss of efficiency and a corresponding reaction upon the universities and upon science.

Finally, if this policy were confined to the geological survey proper there would be less to fear from it. But unfortunately the geological survey has expanded far beyond the legitimate fields of geologic work. Forestry, irrigation, water-supply, reclamation and engineering have been added to its functions, and it has occasionally looked longingly toward the Coast and Geodetic Survey, and I know not what more besides. This expansion, under Mr. Walcott's policy, simply increases the field of its possible powers of demoralization for education and science.

Furthermore, this same policy is already being put into active operation in the Carnegie Institution, and Mr. Walcott is now a candidate for the position of secretary of the Smithsonian Institution, where he could be counted upon to put it in still further practise. With a great overgrown national bureau already committed to this policy and with these two endowed institutions of research under similar control, the university professors of the sciences in this country and the universities themselves are face to face with a serious problem.

In connection with this question I have frequently been reminded that the geological survey has come to be a great scientific trust; that trusts and trust methods are in the air, and that there is little hope of success in fighting them, especially in view of the support commanded by the millions of dollars they receive every year. Very true; but there is also in this same air protest, rebellion and resentment against these high-handed methods, and especially so when they are paid for out of the national treasury.

J. C. Branner.
Stanford University, California,
November 22, 1906.

Evolution (Cook) and Mutation (Waagen).

Dr. O. F. Cook recently has published[1] a reply to my criticism of his views published some time ago,[2] but it only evades the main point at issue, and introduces, in its stead, a new topic, which had not entered the discussion before.

While I practically said, with reference to a previous article of Dr. Cook's,[3] that his distinction between 'evolution' and 'speciation,' although correct, is not new, and objected to the term 'evolution,' he meets this with the rejoinder, that there is a distinction between 'heterism' and 'evolution'; and since he regards this distinction as new, as a progress in science, he claims the right to use the old term evolution in a new, restricted sense.

However, also this new point in the discussion does not justify Dr. Cook, for it is *not new to science*. 'Evolution,' as he understands it, has been often classed with 'variation,' as I have also done in my previous article. Nevertheless, as Dr. Cook maintains, there *is* a distinction between 'evolution,' the 'progressive transformation of species' in time, and 'heterism' (or variation proper) of coexisting individuals. But in this sense 'evolution' is absolutely identical with

[1] Science, September 7, 1906, p. 303.
[2] Science, April 27, 1906, p. 667.
[3] Science, March 30, 1906, p. 506.

what Waagen[4] called 'mutation,' a term that has been accepted and frequently used by paleontologists (for instance Neumayr,[5] W. B. Scott[6] and also the present writer[7]). The same idea is implied in Eimer's term 'orthogenesis,'[8] which has also been used by subsequent writers.[9] Thus, 'other terms being available,'[10] there is absolutely no need to accept the confusing change of the meaning of the word 'evolution.'

Dr. Cook holds, that 'evolution' (correctly, according to the rule of priority, 'mutation,' Waagen) is made possible by two factors, 'heterism' (the normal diversity of individuals) and 'symbasis' (interbreeding = amphimixis, Weismann). This is by no means correct, for it is unintelligible how interbreeding of different individuals should be able to result in a 'progressive change' of the species. Amphimixis only serves to maintain the average of a number of individuals, which vary around this average,[11] and, moreover, it is not an absolutely necessary factor in evolution (old sense), which is evident at once, when we consider that there are organic forms, which lack sexuality.

As to the real causes of mutation (Waagen) I refer to my discussion of this subject in a previous paper,[12] which in the main accepts the views set forth by Pfeffer in a special treatise on this question.[13] According to this, mutation of a species, its transformation in time, is the evolutionary process restricted to a single species; it includes all factors of evolution (old sense) except one, segregation, which, when added, causes the splitting up of one species into two or more.

With reference to my belief that acquired characters are transmitted, and that all variation is due to environment, Dr. Cook maintains that 'heterism,' the diversity of coexisting individuals, is 'normal,' that is to say, an innate quality of organisms, and he asserts that there are no facts which support the doctrine that conditions of environment cause this diversity. I recommend to him to read again the last two paragraphs of my article,[14] and further, what I have said on these topics elsewhere,[15] for he has not paid attention to these arguments. The thesis propounded by Dr. Cook, that 'individual diversity persists in spite of uniformity of conditions,'[16] may be met by the antithesis: *if the environment remains uniform, perfect uniformity of individuals will result.*[17] But since it is practically impossible that any two individuals grow up under precisely the same conditions, a diversity of individuals results. This is a fundamental law. It is, however, not an innate, inexplicable quality of organisms, but is due to the external conditions, which continuously are changing and varying,

[4] 'Die Formenreihe des Ammonites subradiatus,' in Benecke's 'Geogn.-Palæontol. Beitr.,' 2, pp. 179–256.

[5] 'Die Staemme des Thierreichs.' 1, 1889, pp. 60, 61.

[6] 'On the Osteology of Mesohippus and Leptomeryx, with Observations on the Modes and Factors of Evolution in the Mammals,' in *Journ. Morphol.*, 5, 1891, p. 387, 388. 'On Variations and Mutations,' in *Amer. Journ. Sci.*, 48, 1894, p. 355.

[7] 'Grundzüge der marinen Tiergeographie,' 1896, pp. 30, 31. 'On Natural Selection and Separation,' in *Pr. Amer. Phil. Soc.*, 35, 1896, p. 176.

[8] 'Die Artbildung und Verwandtschaft bei den Schmetterlingen,' 2, 1895, p. 3. 'Orthogenesis der Schmetterlinge,' 1897, pp. i–xii.

[9] For instance, quite recently by Paul Sarasin, in *Verh. deutsch, zool. Ges.*, 1906, p. 137.

[10] Ortmann, in SCIENCE, *l. c.*, p. 668. 'Transformation' might also answer; it corresponds to the German 'Umwandlung,' as used by Pfeffer.

[11] See Ortmann, in *Biolog. Centralblatt*, 18, 1898, pp. 146–149. (In opposition to Weismann's view of the action of amphimixis; see Weismann, 'Amphimixis,' 1891.)

[12] *Pr. Amer. Phil. Soc., l. c.*

[13] Pfeffer, 'Die Umwandlung der Arten, etc.,' in *Verh. Naturw. Ver. Hamburg* (3), 1, 1894.

[14] SCIENCE, *l. c.*, p. 669.

[15] *Biol. Centralbl., l. c.*, p. 153. SCIENCE, June 22, 1906, p. 951.

[16] SCIENCE, *l. c.*, p. 306.

[17] See Davenport, in SCIENCE, November 25, 1904, p. 704: 'Two individuals of the same family develop alike only under the same conditions of environment.' See also Copeland, in *Bot. Gaz.*, 38, 1904, p. 426.

and thus a uniform response of individuals to environment is rendered impossible.[18]

A. E. Ortmann.

Carnegie Museum, Pittsburg, Pa.,
September 22, 1906.

DISCONTINUOUS VARIATION.

Dr. Jordan's kindly comment upon my Wood's Hole lecture would place me at a great disadvantage if I were inclined to be controversial (Science, 24: 399, 1906). This, however, is farthest from my purpose, and in fact is unnecessary since I find myself in agreement with him on most of the points brought up.

Too much emphasis can not be put upon some of the statements reiterated or advanced by Dr. Jordan, and he has certainly performed a very useful service by approving the principle that the students of a group, or of any phase of life are more likely to acquire better first-hand knowledge of it, and to render truer interpretations of the facts obtained than other writers. As vividly obvious as this may be, it has been necessary to be unpleasantly insistent upon it upon various occasions during the last few years, and to reassert that botanists are better fitted by opportunities and training for the comprehension of the nature and behavior of plants than any other class of naturalists. The dictum of Darwin so aptly quoted has never been more strictly applicable than at the present time, and an intimate and accurate acquaintance with a large number of species constitutes a very important share of the competency for profitable study of evolutionary problems. Whether or not the investigator publishes his descriptions is purely incidental.

On the other hand, it is not to be granted (and happily it is not) that a keen critical sense in nomenclature, or a zeal for the acquisition, making or conservation of type specimens forms a suitable equipment for the intelligent consideration of genetics, although when coupled with detailed studies in life-histories, cultures and field observations, the activities in question become of very great value in this connection.

During the last few years I have had occasion to discuss the species-idea with several of the more active systematic botanists, and find that the theoretical conceptions of species formulated by them vary widely, although overlapping in many essential points in all instances. Now these differences of opinion by no means lead me to deprecate species-making, or to distrust the value of the species erected by these workers, although known to apply differing standards. This knowledge and this confidence are shared by the general botanical public. The difficulty in delimiting in so many words the difference between continuous and discontinuous variation is of a similar character, and was recognized by myself in the earliest review of the work of de Vries on the subject published in an American journal in the following words: "From the reviews and discussions which have already been made of de Vries' papers it is to be seen that the greatest misunderstanding which may likely arise in the consideration of his results will be that founded on the error of confusing fluctuating variability and mutability." In this as well as in the consideration of species it is found that our difficulties disappear when we deal with concrete examples, especially if embraced in a pedigreed culture. To be able to examine a number of organisms in the field and determine which are continuous and which are discontinuous variants is not possible, for numerous reasons, although many botanists have assumed to do so.

What the actual origin of *Œnothera Lamarckiana* may have been can not be said: we can vouch for the actual origin of but few species. If records are to be trusted, however, it was in cultivation in the Paris Garden a century ago. My own breeding experiments have included a number of crosses involving various combinations of species from eastern

[18] See Brooks, 'Heredity and Variation: Logical and Biological,' in *Pr. Amer. Philos. Soc.*, 45, 1906, p. 75. 'The species is * * * in that reciprocal interaction between the living being and the natural world, of which it is a part.' This paper of Brooks is quite interesting and important. Although largely written in terms rather unusual in the discussion of evolutionary matters, it brings out ideas, which, if I correctly understand them, are essentially in agreement with my own views.

North America as indicated, have been under way for several years, have been visited by perhaps a dozen zoologists interested in problems of heredity as well as by a large number of botanists. When the major purpose of the cultures shall have been accomplished it will be possible to publish the account of the whole to some advantage.

In re hybrids I venture to suggest that if I were a 'Mendelist' of the strictest sect I would welcome a challenge to bring the oak and walnut hybrids under the chess-board diagrams for the exposition of the possible combinations. The unflinching advocates of the Mendelian formulæ are confronted with much more serious difficulties than the examples in question. The enormous accretions being made in the range of authenticated facts of inheritance in hybridization have thrown the whole subject into a state of flux and not for a long time may we hope to work under such simple generalizations as those which contented us a decade since.

It is not intended to maintain that the horse has climbed up on his tiptoes, the bacterium settled into its highly specialized medium and that the orchids have come by their intricate flower-mechanism by the same process. Selection undoubtedly plays an important part, although we seem unable to agree upon the manner in which it operates. One can not be a field student of plants to any great extent without coming upon striking facts in segregation and isolation. This is found especially in the studies now being made of the distribution of the components of the flora of the Bahamas and West Indies. Until we see further around the bend of the road, however, we may make but futile guesses as to the direction of the straight-away beyond. The great amount of energy now being put on detailed studies in this subject at the Desert Laboratory and elsewhere is yielding a great range of diverse data, and affords the hope that some definite conclusions may be expected, within a time comparatively brief, when contrasted with the long barren period in which nothing of definite value as evidence in evolutionary problems has been produced.

In this and other phases of the subject we are confronted with the necessity of placing ourselves alongside some of the organisms which share the earth with us, in order to follow with them along their devious trails for what distance we may, and thus gain some clue as to the rate, direction and character of their movements.

D. T. MACDOUGAL.
DEPARTMENT OF BOTANICAL RESEARCH,
CARNEGIE INSTITUTION OF WASHINGTON,
October 8, 1906.

THE PUBLIC HEALTH DEFENCE LEAGUE.

TO THE EDITOR OF SCIENCE: With the object of devising ways and means for the preservation of the public health and morals there was held in New York City on November 15, an important conference, which should be of interest to readers of SCIENCE. Several hundred delegates from over a hundred well-known organizations then gathered in the Hudson Theater and launched the Public Health Defence League. The inclement weather without did not in any way dampen the enthusiasm of those who were enlisting themselves in a fight to down quackery in any of its various forms and to enforce existing laws for the securing of pure food and drugs, for the suppression of the criminal abortionist, and for other lines of work of a similar nature.

The conference committee consisted of: Dr. Wendell C. Philips, Silas F. Hallock, Dr. Floyd M. Crandall, Dr. Henry W. Cattell, Walter F. C. Tichborne, Albert M. Austin, Dr. Walter Lester Carr, Mr. Howard J. Rogers, Dr. Ernest J. Lederle, Mr. J. M. Rice, Harold P. Brown, Dr. Henry S. Stearns, Livingston Farrand, Rev. J. J. Wynne, Dr. William M. Polk, O. E. Edwards, Gaylor S. White, Dr. Frank Van Fleet, Eugene O'Dunne, Rev. Thomas R. Slicer, Dr. Thomas Darlington, Austen G. Fox, Dr. William L. Browning, Robert E. Belcher, John S. Cooper and Champe S. Andrews, much credit being due to the latter gentleman for his work in organizing the meeting.

Mr. Austen G. Fox, who did such good work as attorney for the committee of fifteen some years ago in regard to the social evil, presided at the meeting. The delegates were welcomed by President McGowan, of the Board of Alder-

men, the first speaker being Mr. Charles F. Stewart, a reporter on the *Cleveland News*. He most entertainingly described how, after a thorough physical examination had shown him to be in good health, the various quacks and charlatans in Cleveland, one of whom was able to expend $80,000 a year for postage stamps alone, pronounced him suffering from various diseases of an unmentionable nature. Among the other speakers were Mr. Eugene O'Dunne, of Baltimore; Mr. Thomas W. Barlow, of Philadelphia, and Mr. Anthony Comstock, of New York.

It seems as if politics can not be run without a boss or the laws upon our statute books be properly enforced without special societies for this purpose. The success of such a movement started from without the medical profession, but with every aid extended to it by physicians, will be even more marked than if it had been undertaken under the auspices of such an organization as the American Medical Association. The chief difficulty to cope with will be to formulate a working plan so that the various branches will be able to cooperate most efficiently with the parent chapter. As was pointed out in the remarks of Dr. Charles A. L. Reed, of Cincinnati, one of the first things to do is to make the laws of our different states bearing upon public health and morals uniform. Thus it would be advisable to have the present United States pure food and drug law passed by the legislature of each state, and to frame a law making it a penal offence to offer to perform a criminal operation and to revoke the license of any physician who upon due process of law has been convicted and sentenced for the performance of such illegal act. To prosecute work of this character and the sanitation of to-day there should be created a national department of health with its head a member of the Cabinet, as so ably advocated by Professor Norton, of Yale. H. W.

SPECIAL ARTICLES.

A STATISTICAL STUDY OF AMERICAN MEN OF SCIENCE. III.

THE DISTRIBUTION OF AMERICAN MEN OF SCIENCE.

From a conventional point of view the distribution of men of science would not be regarded as a psychological problem, perhaps not even as a scientific problem. But in recent years the distribution of plants and animals has received increasing attention in botany and zoology, and apart from its pertinence as a correct description of the world in which we live, it has proved, on the one hand, to have certain practical applications, and, on the other hand, to throw light on certain general problems of heredity and evolution. Similar results may accrue from a scientific study of the distribution of human ability and performance.

The birthplace and the present residence of the thousand leading men of science of the United States are shown on the accompanying table, the divisions used being those of the census. Figures are given separately for the five hundred (I.–V.) who are more distinguished and for the five hundred (VI.–X.) whose reputations are less, followed by the totals and their number per million of the population. As the average age of the scientific men is about 45 years, their birth rate is referred to the census of 1860.[1] Thus the first line of the table shows that 29 of the 1,000 scientific men were born in Maine, and four now reside there. Of the 29 scientific men born in the state, 19 are among the 500 who are more eminent and 10 among the 500 who are less eminent. The number born was at the rate of 46.1 per million of the population at the approximate time of their birth, or one for each 22,000. The scientific population of the state is now only at the rate of 5.7 per million of the population, or scarcely more than one for each 200,000.

There are striking variations in the origin and in the present residence of scientific men throughout the United States. Massachusetts and Boston have been the intellectual center of the country. The birth rate of these leading men of science is in Massachusetts 108.8 per million population; it is 86.9 in Connecticut,

[1] This is not exact, as the age distribution is not symmetrical, and the rate of increase of the population in the different states is not uniform, but the results are as nearly correct as is necessary.

and decreases continually at greater distances from this center. It is reduced to about one half in the surrounding states—46.1 in Maine, 46 in New Hampshire, 57.1 in Vermont and 47.2 in New York. There is a further reduction to one half in Pennsylvania—to 22.7—and this proceeds as we go southwards, the rate being 8.8 in Virginia, 5 in North Carolina, 2.8 in Georgia, 2.1 in Alabama, 1.3 in Mississippi and 1.4 in Louisiana. In the north central states the conditions are intermediate between New York and Pennsylvania. Thus the birth rate per million is 32.1 in Ohio and 36 in Michigan. Here again it decreases as

TABLE I. DISTRIBUTION OF THE THOUSAND MEN OF SCIENCE.

	Birthplace.			Per Million 1860.	Residence.			Per Million 1900.
	I.-V.	VI.-X.	Total.		I.-V.	VI.-X.	Total.	
North Atlantic Division.								
Maine	19	10	**29**	*46.1*	0	4	**4**	*5.7*
New Hampshire	7	8	**15**	*46.0*	2	6	**8**	*19.4*
Vermont	9	9	**18**	*57.1*	0	2	**2**	*5.8*
Massachusetts	60	74	**134**	*108.8*	74	70	**144**	*51.3*
Rhode Island	4	1	**5**	*28.6*	7	1	**8**	*18.7*
Connecticut	26	14	**40**	*86.9*	27	16	**43**	*47.3*
New York	99	84	**183**	*47.2*	93	99	**192**	*26.4*
New Jersey	9	19	**28**	*41.6*	17	18	**35**	*18.5*
Pennsylvania	32	34	**66**	*22.7*	28	37	**65**	*10.3*
South Atlantic Division.								
Delaware	0	2	**2**	*17.8*	0	1	**1**	*5.4*
Maryland	12	14	**26**	*37.8*	24	23	**47**	*39.5*
District of Columbia	1	2	**3**	*39.9*	69	50	**119**	*426.9*
Virginia	5	8	**13**		8	2	**10**	*5.4*
West Virginia	1	0	**1**	*8.8*	2	1	**3**	*3.1*
North Carolina	1	4	**5**	*5.0*	3	3	**6**	*3.2*
South Carolina	2	3	**5**	*7.1*				
Georgia	1	2	**3**	*2.8*	0	1	**1**	*1.4*
South Central Division.								
Kentucky	6	2	**8**	*6.9*	1	2	**3**	*1.4*
Tennessee	5	1	**6**	*5.4*	2	1	**3**	*1.5*
Alabama	1	1	**2**	*2.1*	1	1	**2**	*1.1*
Mississippi	1	0	**1**	*1.3*				
Louisiana	1	0	**1**	*1.4*	0	1	**1**	*.7*
Texas	0	3	**3**	*4.9*	2	5	**7**	*2.3*
North Central Division.								
Ohio	42	33	**75**	*32.1*	13	21	**34**	*8.2*
Indiana	17	11	**28**	*20.7*	4	8	**12**	*4.7*
Illinois	24	18	**42**	*24.5*	36	27	**63**	*13.1*
Michigan	12	15	**27**	*36.0*	22	5	**27**	*11.1*
Wisconsin	11	24	**35**	*45.1*	11	12	**23**	*11.1*
Minnesota	1	3	**4**	*23.2*	3	10	**13**	*7.4*
Iowa	6	14	**20**	*29.6*	5	2	**7**	*3.1*
Missouri	4	10	**14**	*11.8*	7	14	**21**	*6.7*
North Dakata					0	2	**2**	*6.2*
South Dakota					0	2	**2**	*3.9*
Nebraska	1	1	**2**	*69.3*	4	5	**9**	*8.4*
Kansas	5	2	**7**	*65.3*	2	3	**5**	*3.4*
Western Division.								
Montana					0	2	**2**	*8.2*
Wyoming					0	1	**1**	*10.8*
Colorado	0	3	**3**	*87.2*	3	5	**8**	*14.8*
New Mexico					0	2	**2**	*10.2*
Arizona					1	1	**2**	*16.3*
Washington	1	0	**1**	*86.2*				
California	5	6	**11**	*28.9*	23	30	**53**	*35.7*
Alaska					0	1	**1**	*15.7*
Hawaii	1	0	**1**					
Philippine Islands					2	1	**3**	
Total	**432**	**435**	**867**	**27.6**	**496**	**498**	**994**	*13.3*

	Birthplace.			Per Million 1860.	Residence.			Per Million 1900.
	I.—V.	VI.—X.	Total.		I.–V.	V.–IX.	Total.	
Canada	11	23	34	*28.7*	1	1	2	
Brazil					1	0	1	
Cuba					0	1	1	
England	10	15	25	*29.6*	1	0	1	
Ireland	2	1	3	*1.8*				
Scotland	6	3	9	*37.9*				
Wales	0	1	1	*10.7*				
West Indies	0	1	1	*69.1*				
Germany	15	4	19	*7.1*				
Austria-Hungary	4	2	6	*10.4*				
Norway	1	0	1	*2.9*				
Sweden	2	1	3	*5.2*				
Denmark	0	2	2	*12.9*				
Switzerland	4	4	8	*68.9*				
Russia	4	2	6	*7.4*				
Italy		1	1	*2.1*				
Spain	0	1		*137.3*				
Turkey					1	0	1	
India	4	0	4	*193.3*				
China	1	1	2	*18.7*				
Total	64	62	126		4	2	6	
Grand Total	496	497	993		500	500	1000	

we go southward. The rate is 45.1 in Wisconsin, 24.5 in Illinois, 11.8 in Missouri and 6.9 in Kentucky. Westward the total number of scientific men is too small and the population has been too rapidly increasing for the figures to be reliable. Each individual should be considered in connection with the population at the time of his birth, but even in this case the validity of the results would be small.

Of the 1,000 scientific men, 126 were born in foreign countries—34 in Canada, 38 in Great Britain and 19 in Germany. The birthplace of seven is not known. The number per million is for the native population 13.2, and for the foreign-born population 12. These figures have, however, no significance, as the foreign-born population contains a much larger proportion of adult males. The percentage of the white native population in the United States over 40 years of age is 18.4, and of white foreign-born is 44.4. The native population consequently produces more than twice as many scientific men as the foreign-born, even without regard to the excess of males among the foreign-born, the inclusion of the colored races among the native-born and the fact that many of the foreign-born have been called to this country on account of their scientific standing. The different nations contribute scientific men in very unequal measure, the numbers per million foreign-born being as follows: Switzerland, 68.9; Scotland, 37.9; England, 29.6; Canada, 28.7; Austria-Hungary, 10.4; Russia, 7.4; Germany, 7.1; Sweden, 5.2; Italy, 2.1; Ireland, 1.8; France, 0. These differences can not be attributed to race, as they do not represent the scientific productivity of these nations, but only of the classes that have emigrated to this country. While it is not possible to deny that the variations are dependent on the kinds of family stocks, it is probable that they are due in much larger measure to social and economic conditions. The native-born sons of Irish-born parents may not be inferior in scientific productivity to other classes of the community.

The inequality in the production of scientific men in different parts of the country seems to be a forcible argument against the view of Dr. Galton and Professor Pearson that scientific performance is almost exclusively due to heredity. It is unlikely that there are such differences in family stocks as would lead one part of the country to produce a hundred times as many scientific men as other parts. The negroes may have a racial

disqualification, but even this is not proved. The main factors in producing scientific and other forms of intellectual performance seem to be density of population, wealth, opportunity, institutions and social traditions and ideals. All these may be ultimately due to race, but, given the existing race, the scientific productivity of the nation can be increased in quantity, though not in quality, almost to the extent that we wish to increase it.

There may be no significant difference in the distributions of the first and second groups of 500. Some states have produced men of higher average standing than others, but the differences are within the range of possible chance variations. Thus Maine has produced 19 men of the first rank and 10 of the second. But if 29 pennies are tossed up, there is one chance in 14 or 15 ($P = .068$) that there will be 19 or more heads. It is, however, true, as a matter of fact, that Maine, Connecticut, Ohio, Indiana and Illinois have produced men of decidedly higher average standing than New Jersey, Wisconsin, Iowa and Missouri. Those born in Germany are considerably above and those born in Canada are below the average, and the figures may here represent a real difference in the classes drawn to this country.

The fact that there is not a significant difference in the average standing of scientific men born in different regions of the country tends to support the conclusion that scientific performance is mainly due to environment rather than to innate aptitude. If the fact that Massachusetts has produced relatively to its population four times as many scientific men as Pennsylvania and fifty times as many as the southern states were due to a superior stock, then we should expect that the average standing of its scientific men would be higher than elsewhere; but this is not the case. Like most arguments intended to disentangle the complex factors of 'nature and nurture,' this, however, is not conclusive. If scientific ability were innate, each tending to reach his level in spite of environment, then a potentially great man of science would become such wherever born, and we might expect a favorable environment to produce mediocre men, but not great men. But this argument is answered by the small number of scientific men from certain regions of the country. Differences in stock can scarcely be great enough to account for this; it seems to be due to circumstance. A further analysis of the curves of distribution might throw light on the problem. Thus it might be that the men of greatest genius were independent of the environment, while men of fair average performance were produced by it. Examples might be given in favor of this view, but I can not see that it is supported by the forms of the curves of distribution. I hope at some time to take up the question from a study of individual cases, but I have not as yet the data at hand. My general impression is that certain aptitudes, as for mathematics and music, are mainly innate, and that kinds of character and degrees of ability are mainly innate, but that the direction of performance is mainly due to circumstances, and that the environment imposes a veto on any performance not congenial to it.

The present distribution of the 1,000 men of science is somewhat the same as their origin. The population of the country has more than doubled since 1860, and the number of these scientific men per million population is consequently less than half the number per million at the period of their birth. There are in Massachusetts 144 of the 1,000, which is 51.3 per million of the population, according to the census of 1900. The numbers then decrease to 26.4 per million in New York, 10.3 in Pennsylvania, 13.1 in Illinois, 8.2 in Ohio, 3.1 in Iowa, 1.1 in Alabama, 0.7 in Louisiana and 0 in Mississippi. The most striking development has been the attraction to Washington of a large group of scientific men, 119 of the thousand, nearly all in the service of the government. This number has been almost exactly supplied to the country by the excess of scientific men born abroad—120. This leaves an equal balance between the gains and losses of other parts of the country. The greatest gain has been made by California, which has drawn 42 of the scientific men from other states; Illinois and Maryland have each gained 21. Other states have gained consider-

ably in proportion to their total scientific population—New Jersey, 7, Minnesota 9, Missouri 7, Nebraska 7 and Colorado 5. These gains appear to be significant, attributable to the establishment and growth of universities.

Massachusetts, New York and Pennsylvania have remained nearly stationary. Massachusetts has gained ten of the scientific men and New York nine, while Pennsylvania has lost one. The conditions in New York are by no means creditable to that state, in view of its great increase in wealth. Outside New York City, the state has lost 31 men of science, nearly one third of those it has produced, and half the others are concentrated at Ithaca. The conditions are somewhat similar in Massachusetts and Pennsylvania, outside Boston, Cambridge and Philadelphia.

The rural New England states, Maine, New Hampshire and Vermont, have lost 48 of the 62 scientific men whom they have produced. This is a loss that they can ill afford; it signifies a distinct decadence. Had each of these states provided an income of $50,000 to retain these men in their service, they would have been repaid manyfold, commercially as well as intellectually. The conditions in some of the north central states are also ominous, though more likely to improve. Thus Ohio has lost forty-one of its scientific men, more than half of those whom it has produced; Indiana has also lost more than half and Iowa just half. The south remains in its lamentable condition of scientific stagnation, but we may hope that material progress will be followed by an intellectual awakening. All these figures become more impressive when we remember that they indicate performance in scholarship, in literature and in art, as well as in science. It would be well if they were widely known, as they would tend to awaken civic pride and to improve the conditions of intellectual activity.

The average standing of the scientific men residing in different parts of the country varies a little more than the standing of those produced in different regions and is perhaps less likely to be due to chance variations. This appears to be somewhat paradoxical from the point of view of the theory of probabilities. The fact that of the 75 scientific men born in Ohio, 42 belong to the first group and 33 to the second is a natural result of chance distribution, and the fact that of the 34 scientific men remaining in the state, 13 belong to the first group and 21 to the second might equally well be the result of chance distribution. But apparently it is not. Ohio has lost more than half the scientific men it has produced; it has lost two thirds of its better men and one third of its more mediocre men. The state has not provided for its scientific men, and has provided less adequately for the better men than for those who are not so good. Indiana has lost three fourths of its men of the first class and one fourth of those of the second class. The three rural New England states have lost seventeen eighteenths of their men of the first class and one half of those of the second class. These conditions are significant and serious.

Other states have improved their positions. Thus, thanks to its great university, Michigan has 22 men in the first group as compared with five in the second. Thanks again to its universities, Illinois has increased its number of scientific men from 42 to 63, of whom 36 are in the first class. California, Missouri and Minnesota have, on the other hand, called men who are below the average.

The large centers of scientific population in Massachusetts and New York have about maintained their positions, having produced men of about average standing and their resident men of science being of about average standing. Massachusetts has, however, gained a little and New York has lost a little. Of the 119 scientific men in Washington, 69 are in the first group and 50 in the second. This appears to me to be a fact of very great importance. It is commonly said that less able scientific men are attracted to the government service, that those who are able leave it for university positions and that those who stay are not encouraged to do their best work. Such statements are refuted by these statistics. The average performance of the scientific men at Washington is higher than in Massachusetts or in New York. This conclusion is most gratifying to those of us who believe that the future of scientific research depends large-

ly on its support by the nation, the states and the municipalities.

The writer has on various occasions called attention to the economic conditions which limit scientific research. As one of the objects of the present work is to improve these conditions, it may be well to repeat here the argument. Our economic system rests on the free exchange of services. A state of society may some day be reached in which each will aim to give as much as he can and to take as little, but at present it appeals to our sense of fairness that each should ask for his services what someone else is willing to pay. In the increasing complexity of our society this method is working two serious injustices. One of these is the formation of monopolies. Thanks chiefly to the applications of science, many services can now be supplied at a cost less than people would be willing to pay. When free competition is excluded, either by the conditions of the case or by ingenious combination, people may be made to pay more than a fair return for certain services. The problems of monopoly are being discussed on all sides, and remedies are being sought in all directions; but the injustice which in a way is the converse of monopoly has scarcely been noticed. This is the case in which an individual gives services without an adequate return, owing to the fact that they are not rendered to a single individual or group who will pay for them, but to society as a whole. A surgeon may ask for an operation for appendicitis as large a fee as his patient is willing to pay, but should he after years of research discover a method of preventing appendicitis altogether, he would receive no payment at all, but would, on the contrary, give up all future fees for the operation. The surgeons who by risking and sacrificing their lives discovered how to suppress yellow fever have received no return for their great work.

The two most important services for society —the bearing and rearing of children and creation in science and art—are exactly those for which society gives no economic returns, leaving them dependent on instincts which are in danger of atrophy. This state of affairs not only does injustice to the unrewarded individual, but works immeasurable harm to society—a greater injury probably than all existing monopolies. There are more than a hundred thousand physicians in the United States who are practising on their patients for fees, while there are scarcely two hundred who are studying seriously the causes of disease and the methods of preventing it. The conditions are similar in law and in all professions and trades. The scientific investigator is usually an amateur. He has wealth or earns his living by some profession, and incidentally does what he can to advance science for love of the work. This has its good side in producing a small group of men who are not subject to purely commercial standards. But this is after all a minor factor, and the scientific man is likely to look for fame, which is scarcely more ideal than money and can be supplied to but few. Satisfaction in the work itself is the best reward for work; but no one can know that his work is of value except by the reflected appreciation of others, and in the existing social order the simplest and probably the most adequate expression of this appreciation is direct payment for the service rendered.

The methods that society has devised to meet this situation, apart from the conferring of honors and fame, are recent and inadequate. Copyrights and patents are the most direct acknowledgment of property in ideas. They have accomplished a good deal, and their scope should be extended. At present only a small part of discovery is covered by the patent office, and this perhaps not the part requiring the greatest genius. It is, however, leading, especially in Germany, to the development of discovery on a sound commercial basis. It is said that one chemical firm employs three hundred doctors of philosophy to carry on scientific investigations. Research has hitherto been forwarded mainly by the universities, where again Germany has led the way. The professorship is given as a reward for successful investigations, and the holder of a chair is expected to devote himself to investigation as well as to teaching. There is a tendency to permit certain professors to engage almost exclusively in research. Thus the astronom-

ical observatories of Harvard, Chicago and California universities are purely research institutions. A further step has been taken in the endowment of institutions, such as the Carnegie Institution and the Rockefeller Institute, explicitly for research. The most logical and important advance, however, consists in the direct conduct of research by the government. As the government should control monopolies, so it should conduct the work which is not for the benefit of a single individual, but for the people as a whole. There are, of course, no end of difficulties in the control of monopolies or the conduct of research by a municipality, state or nation; but it is exactly these difficulties that it is our business to overcome. We may congratulate ourselves that our national government is at present accomplishing more for research and the applications of science than the government of any other nation, and that the men of science working under the government are doing their full share for the advancement of science.

Table II. gives the cities in which five or more of the thousand scientific men were born, and the cities in which five or more of them now reside. The tendency towards concentration which we know to exist is here measured. Two hundred and twenty-seven of the scientific men were born in places producing five or more, and 782 of them live in places where there are five or more. This is, of course, natural, and probably desirable; scientific work is accomplished where men gather together. Still the fact that three fourths of our scientific men live in 39 places—with a good many more in the suburbs—leaves rather a scanty number for the rest of the country. We have, however, more separate scientific centers than foreign countries, and by this circumstance we both gain and lose. The lack of men of distinction in whole regions and large cities is a serious indictment of our civilization. The existence of cities such as Brooklyn and Buffalo is an intellectual scandal.

Of the 866 men native to the United States, 224 were born in the cities which in 1900 had a population of more than 25,000. These

Table II. Distribution in Different Places.

	According to Birthplace.			Per Million 1860.
	I.-V.	VI.-X.	Total.	
New York, N. Y.	33	25	58	*71.2*
Boston, Mass.	24	19	43	*241.8*
Philadelphia, Pa.	12	16	28	*49.5*
Baltimore, Md.	9	11	20	*94.1*
Cincinnati, O.	6	6	12	*74.5*
Brooklyn, N. Y.	3	8	11	*39.4*
Chicago, Ills.	5	3	8	*73.2*
Buffalo, N. Y.	3	4	7	*86.2*
St. Louis, Mo.	2	5	7	*43.5*
Cambridge, Mass.	4	2	6	*230.2*
Cleveland, O.	4	2	6	*140.5*
Salem, Mass.	1	5	6	*269.6*
Milwaukee, Wis.	1	4	5	*110.5*
Newark, N. J.	3	2	5	*69.5*
San Francisco, Cal.	2	3	5	*88.0*
Total.	112	115	227	

	According to Residence.			Per Million 1900.
	I.-V.	VI.-X.	Total.	
Washington, D. C.	69	50	119	*426.9*
New York, N. Y. }	61	54	115	*56.1*
Brooklyn, N. Y. }	1	3	4	*3.4*
Cambridge, Mass.	30	22	52	*576.8*
Chicago, Ills.	29	16	45	*26.5*
Baltimore, Md.	22	16	38	*74.6*
New Haven, Conn.	24	10	34	*314.7*
Philadelphia, Pa.	14	20	34	*26.3*
Boston, Mass.	14	19	33	*58.8*
Ithaca, N. Y.	17	15	32	*2436.1*
Ann Arbor, Mich.	20	5	25	*1723.1*
Madison, Wis.	7	11	18	*939.2*
Berkeley, Cal.	8	9	17	*1286.5*
Palo Alto, Cal.	9	7	16	*9650.2*
Princeton, N. J.	8	6	14	*3590.6*
Minneapolis, Minn.	3	8	11	*54.3*
St. Louis, Mo.	6	5	11	*19.1*
Worcester, Mass.	7	4	11	*229.6*
Cleveland, O.	6	4	10	*26.2*
Columbus, O.	3	7	10	*79.6*
San Francisco, Cal.	1	9	10	*29.1*
Columbia, Mo.	1	8	9	*1592.6*
Lincoln, Nebr.	4	5	9	*224.0*
Syracuse, N. Y.	0	9	9	*83.0*
Cincinnati, O.	2	6	8	*24.5*
Bryn Mawr, Pa.	2	5	7	*?*
Evanston, Ills.	5	2	7	*363.4*
Middleton, Conn.	2	5	7	*730.0*
Bloomington, Ind.	3	3	6	*328.8*
Brookline, Mass.	4	2	6	*300.9*
Charlottesville, Va.	5	1	6	*930.7*
Iowa City, Ia.	4	2	6	*751.2*
Mt. Hamilton, Cal.	4	2	6	*?*
Northampton, Mass.	2	4	6	*321.8*
Providence, R. I.	5	1	6	*34.2*
Albany, N. Y.	3	2	5	*53.1*
Amherst, Mass.	3	2	5	*994.9*
Chapel Hill, N. C.	3	2	5	*4549.6*
Lawrence, Kans.	2	3	5	*460.3*
New Brunswick, N. J.	2	3	5	*249.9*
Total.	415	367	782	

places had in 1860 a population of about 4,500,000 as compared with a rural population of about 27,000,000. The urban population was about one sixth of the rural population and produced more than a quarter of the scientific men. The urban birth rate was 50 and the rural birth rate was 23.8. The superior position of the towns is doubtless due to a more favorable environment, but it may also be in part due to the fact that the parents of these scientific men were the abler clergymen and others of their generation who were drawn to the cities.

Table III. gives the institutions with which three or more of the scientific men are connected, and in the case of institutions in which there are more than fifteen the details of their rank are shown, I., II., etc., representing the first hundred, the second hundred, etc. I give this table with some hesitation, but it appears that in the end it will be for the advantage of scientific research if it is known which institutions obtain and retain the best men. Harvard has 66.5 of the scientific men, the half (0.5) being used when a professor is emeritus or gives only part of his time to an institution. Columbia follows with 60, and Chicago comes next with 39. In both the U. S. Geological Survey and the Department of Agriculture there are 32. About half of the scientific men are connected with 18 institutions. Harvard has not only the largest number of scientific men, but they are also of the highest rank, 19 being in the first hundred and 8.5 in the second hundred. Johns Hopkins has nine in the first hundred and Columbia and Chicago each has seven. A table such as this might have some practical influence if the data were made public at intervals of ten years.

Table IV. gives the institutions at which the 1,000 men of science pursued their studies. A man is credited for his degree to the first institution at which he took it, but in the case of graduate study, he may have attended several institutions. He is not, however, credited

TABLE III.—DISTRIBUTION ACCORDING TO PRESENT POSITION OF THE THOUSAND MEN OF SCIENCE.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	Total.
Harvard	19	8.5	3	6.5	3.5	6	4.5	5.5	3.5	6.5	66.5
Columbia	7	6	6.5	4.5	5	4.5	5.5	6	4	11	60
Chicago	7	10	3	6	2	2.5	3	2	1.5	2	39
Cornell	3	6	3	2	3	1.5	3	3.5	4	4.5	33.5
U. S. Geological Survey	6	3	4	4	4	1	3	3	2	2	32
U. S. Department Agriculture	3	4	2	4	3	2	3	3	3	5	32
Johns Hopkins	9	2	5.5	0	1.5	2	4.5	0.5	1	4.5	30.5
California	1	2	2	4	3	4	1	5	1	4	27
Yale	2	5.5	3	3.5	5.5	2	1	0	2	2	26.5
Smithsonian Institution	3	2	4	4	2	0	1	3	1	2	22
Michigan	1	3	6	3	3	0	0	1	1	2	20
Mass. Inst. Tech.	1	2	2.5	4	2	3	2	0	0	3	19.5
Wisconsin	1	3	1	2	0	3	2	4	2	0	18
Pennsylvania	2	1	1	3.5	2.5	1.5	1	2	0.5	2	17
Leland Stanford, Jr.	3	1	1	1	3	2	2	1	1	1	16
Total											459.5
Princeton											14.5
Minnesota, Ohio State											10
New York University											9.5
Missouri, Nebraska, Northwestern											9
National Bureau of Standards, U. S. Navy, Am. Mus. Nat. History											8
Carnegie Institution, Clark, Iowa, Syracuse, Virginia, Wesleyan											7
Bryn Mawr, Cincinnati, Dartmouth, Illinois, Indiana, N. Y. Botanical Garden, Smith											6
Brown, Kansas, North Carolina, Texas, Washington (St. Louis)											5
Field Columbian Museum, General Electric Co., St. Louis, Western Reserve, Pennsylvania State, Rutgers											4
Lehigh											3.5
Philadelphia, Acad. Nat. Sciences Amherst, Case, College of City of New York, Colorado College, Colorado University, Haverford, Purdue, Rockefeller Institute, Simmons, Tufts, Vassar, Worcester											3
Grand Total											730

TABLE IV. ATTENDANCE OF THE THOUSAND MEN OF SCIENCE AT DIFFERENT INSTITUTIONS.

	Bachelor's Degree.			Graduate Study.			Ph.D.			Grand Total.
	I.-V.	VI.-X.	Total.	I.-V.	VI.-X.	Total.	I.-V.	VI.-X.	Total.	
Harvard	55	51	*106*	38	36	*74*	30	27	*57*	**237**
Johns Hopkins	12	15	*27*	27	15	*42*	50	52	*102*	**171**
Yale	35	17	*52*	9	4	*13*	14	14	*28*	**93**
Columbia	12	16	*28*	9	3	*12*	11	27	*38*	**78**
Cornell	19	12	*31*	4	13	*17*	10	16	*26*	**74**
Michigan	23	12	*35*	4	4	*8*	8	2	*10*	**53**
Princeton	11	12	*23*	5	7	*12*	4	4	*8*	**43**
Chicago	0	2	*2*	3	11	*14*	12	11	*23*	**39**
Mass. Inst. Tech.	13	13	*26*	3	6	*9*	0	0	*0*	**35**
Amherst	12	11	*23*	2	3	*5*	0	1	*1*	**29**
Clark	0	0	*0*	5	11	*16*	4	8	*12*	**28**
Pennsylvania	5	10	*15*	2	2	*4*	3	6	*9*	**28**
Wisconsin	4	10	*14*	1	4	*5*	2	2	*4*	**23**
California	5	7	*12*	3	3	*6*	3	1	*4*	**22**
Wesleyan	9	7	*16*	2	3	*5*	0	0	*0*	**21**
Indiana	4	4	*8*	2	4	*6*	4	0	*4*	**18**
Nebraska	5	5	*10*	4	2	*6*	1	1	*2*	**18**
Williams	6	8	*14*	0	2	*2*	0	1	*1*	**17**
Dartmouth	5	5	*10*	2	1	*3*	0	1	*1*	**14**
Oberlin	6	4	*10*	2	2	*4*	0	0	*0*	**14**
College City N. Y.	7	4	*11*	1	1	*2*	0	0	*0*	**13**
Geo. Washington	3	2	*5*	2	0	*2*	3	3	*6*	**13**
Brown	4	4	*8*	1	2	*3*	0	0	*0*	**11**
Iowa	2	4	*6*	1	2	*3*	1	0	*1*	**10**
Toronto	5	13	*18*	3	3	*6*	0	0	*0*	**24**
Edinburgh	2	1	*3*	0	3	*3*	2	3	*5*	**11**
Cambridge	2	0	*2*	3	5	*8*	0	0	*0*	**10**
Berlin				53	42	*95*	11	11	*22*	**117**
Leipzig				30	15	*45*	27	12	*39*	**84**
Göttingen				18	18	*36*	19	14	*33*	**69**
Heidelberg				27	14	*41*	7	8	*15*	**56**
Munich				13	5	*18*	6	7	*13*	**31**
Strasburg				13	4	*17*	3	3	*6*	**23**
Freiburg				10	5	*15*	3	1	*4*	**19**
Bonn				10	4	*14*	2	2	*4*	**18**
Zürich				5	6	*11*	1	2	*3*	**14**
Vienna				9	3	*12*	0	0	*0*	**12**
Würzburg				4	3	*7*	3	2	*5*	**12**
Paris				21	7	*28*	0	1	*1*	**29**
Total	**266**	**249**	**515**	**351**	**278**	**629**	**244**	**243**	**487**	**1631**

as a graduate student to the institutions from which he received the doctorate.[2] The total influence of Harvard is 237, of the Johns Hopkins 171, of Yale 93, of Columbia 78 and of Cornell 74. About one tenth of the men of science received their bachelor's degree from Harvard and about the same number their doctor's degree from the Johns Hopkins. It is not certain that a preponderance of scientific men has been produced at any institution as compared with the total number of students, and it appears that those who attend the larger universities are not of higher average performance than others. Thus of the 106 who have taken the bachelor's degree at Harvard, 55 are in the first rank and 51 in the second. Yale, Cornell and Michigan have produced men above the average rank, and the excess is such that it is probably significant, though the departures fall within the limits of possible chance variation. On the whole,

[2] The doctorates include the comparatively few cases in which the degree of doctor of science has been conferred in course.

however, there is no significant difference in rank between the 515 men who attended the larger institutions and those who attended smaller colleges or none. It might be supposed that abler students would be attracted to a university such as Harvard, and that they would have greater opportunities there, but this appears not to be the case. So far as it goes, this favors the theory that men of science are born such and are not dependent on the environment for the quality of their performance. It may, however, be that relatively more men of mediocre ability are led to take up scientific work at an institution such as Harvard, whereas only those of genius are likely to break through the barrier of an unfavorable environment.

The conditions are similar in the case of the doctor's degree. Of the 487 men who have received it from the larger institutions, 244 are of the first rank and 243 of the second; nor do any institutions excel, unless it be Leipzig and Göttingen. Those who pursue graduate studies at institutions from which they do not take the degree are of distinctly higher standing than the average A.B. or Ph.D. This is probably because the abler and more energetic men have attended several institutions, more especially abroad, many of them having worked in foreign universities even after having obtained scientific distinction.

The thousand men of science under consideration pursued their graduate studies on the average from fifteen to twenty years ago. Since that time a considerable change has occurred in the relative numbers of students attracted to different institutions. Owing to the improvement of our universities relatively fewer students now frequent foreign institu-

TABLE V. SUBJECTS OF THE THOUSAND MEN OF SCIENCE WHO HAVE PURSUED GRADUATE STUDIES OR TAKEN THE DOCTOR'S DEGREE AT DIFFERENT INSTITUTIONS.

	Graduate Study.												Ph.D.												Grand Total.
	Chemistry.	Physics.	Zoology.	Geology.	Botany.	Mathematics.	Pathology.	Psychology.	Astronomy.	Physiology.	Anatomy.	Anthropology.	Total.	Chemistry.	Physics.	Zoology.	Geology.	Botany.	Mathematics.	Pathology.	Psychology.	Astronomy.	Physiology.	Anatomy.	Anthropology.	Total.	
Johns Hopkins	3	8	5	4	3	5	7	2		3	2		*42*	18	24	22	9	1	8	1	6	2	10	1		*102*	144
Harvard	10	8	13	8	12	10	1	7	1	3	1		*74*	9	2	20	7	10	3		4				2	*57*	131
Columbia	3	4		2		1		1		1			*12*	5	5	9	1	5	6		2	2	2		1	*38*	50
Cornell	1	4	3	2	3	2				1	1		*17*	1	14	2		5	1		3					*26*	43
Yale	3	2	2	4		1		1					*13*	8	2	2	5	1	5		2	1	2			*28*	41
Chicago	2	4	1		3		1		2	1			*14*	1	1	11	3	2	3				1	1		*23*	37
Clark	1	2	6			5				1	1		*16*		1	2			1	1	5		1		1	*12*	28
Princeton		1	6			1		2	1		1		*12*	1	3	2			1		1					*8*	20
Michigan		4	2			1		1					*8*		2	1		4		3						*10*	18
Pennsylvania			1				2	1					*4*	3	1	3		1			1					*9*	13
California	1	1	1					1	2				*6*	1			1	2								*4*	10
Indiana		2	1		1			2					*6*			2	1	1								*4*	10
Berlin	18	24	5	3	5	5	10	14	3	4	3	1	*95*	3	12	1			2		1	3				*22*	117
Leipzig	10	2	7	3	2	4	2	8		5	1	1	*45*	11	2	8	1	3	4		9		1			*39*	84
Göttingen	10	5	1	3		9	3	5					*36*	17	2		2		12							*33*	69
Heidelberg	18	2	2	8		3	2	4		1		1	*41*	12			3									*15*	56
Munich	10		2	2			1	1		1	1		*18*	5		1	3	2				1	1			*13*	31
Strasburg	4	1	4		2	1	2		2		1		*17*		2	1		1	1			1				*6*	23
Freiburg	3	1	5	1			2	2		1			*15*	1		2					1					*4*	19
Bonn	2				7			1	1	2		1	*14*		1			2	1							*4*	18
Zürich	6	3	1			1							*11*	2				1								*3*	14
Vienna	1	1					10						*12*													*0*	12
Würzburg	2		3				1				1		*7*		4	1										*5*	12
Paris	5	4	3	3		4	3	6					*28*						1							*1*	29
Total	113	83	74	43	38	53	47	59	12	24	13	4	563	98	78	90	36	41	49	5	35	10	18	2	4	466	1029

tions. The number of doctorates conferred in the natural and exact sciences during the past nine years is as follows: Johns Hopkins, 147; Chicago, 145; Columbia, 137; Harvard, 129; Yale, 120; Cornell, 94; Pennsylvania, 85; Clark, 75. There is then a drop to universities that have conferred fewer than 25 degrees in the sciences during this period. Relatively more work is done in the sciences in some institutions than in others. Thus the percentage of degrees in the sciences in these universities is as follows: Clark, 95; Cornell, 58; Johns Hopkins, 54; Columbia, 49; Chicago, 48; Pennsylvania, 43; Harvard, 42, and Yale, 41.

Table V. shows the institutional origin of men who have pursued different sciences. The Johns Hopkins University has excelled relatively in chemistry, physics, zoology and physiology; Harvard in zoology and botany; Columbia in zoology, botany and mathematics; Cornell in physics and botany; Clark in psychology, and Michigan in botany and pathology. Of the foreign universities, Berlin has excelled in physics, Leipzig in psychology and Göttingen in chemistry and mathematics.

The table also shows that men are more likely to pursue graduate studies and to take the doctor's degree in some sciences than in others. Of the fifty psychologists, 35 have received the doctor's degree from the institutions given in the table, and of the 150 zoologists 90 have received it, whereas only two of the 25 anatomists and only five of the 60 pathologists have received a non-technical higher degree from these universities. While important improvements in the practise of surgery and medicine have been made in this country, it must be admitted that we are not doing our share for the advancement of pathology, anatomy and physiology.

It would be desirable to compare the scientific men and the scientific work of the United States with those of other nations, and I hope to collect data on this subject. It is my impression from such information as is on hand that we produce from one seventh to one tenth of the world's scientific research, but that we have not produced one tenth of its recent great discoveries or of its contemporary great men. With our vast population and unlimited resources, it would be shameful and intolerable to let the future be no better than the present. It is obvious that we should collect without delay the information that would tell us where we stand among the nations.

It is not altogether without interest to find that it is possible to reduce to order facts which might be supposed to be outside the range of the natural and exact sciences. The present articles are, however, only a beginning of a study of scientific men as a group and of the conditions on which scientific performance depends. We have in a large measure explored the material world and subdued it to our uses; it is now our business to secure an equal increase in our knowledge of human nature and to apply it for our welfare. If he is a benefactor to mankind who makes two blades of grass grow where one grew before, his services would be immeasurably greater who could enable two men of science to flourish where there had been but one.

J. McKeen Cattell.
Columbia University.

BRACHIOPOD NOMENCLATURE.

The following is an epitome of the results of some recent investigations; a fuller account of them has been handed to the editor of the *Annals and Magazine of Natural History* (England).

The genera *Epithyris, Hypothyris* and *Cleiothyris* can not be used, as they are now, on King's authority: they must stand or fall by what Phillips did. From what Phillips says of the first two (Pal. Foss. Devon., etc., 1841, pp. 54, 55) the types are as follows:

Genus *Epithyris,* Phillips.

Type *Terebratula maxillata,* Sowerby.

This will be the generic name for the *Terebratula maxillata* group of the Jurassic.

Genus *Hypothyris,* Phillips.

Type *Terebratula concinna,* Sowerby.

This would be the name for a series of Jurassic Rhynchonellæ, but it is preoccupied, and so must drop altogether. However, the terms epithyrid and hypothyrid will be found extremely useful to describe the beak-characters which Phillips noted.

Genus *Cleiothyris,* Phillips.

Type *Terebratula concentrica,* von Buch.

The type here is not so certain; but this seems to be the solution of Phillips's rather ambiguous phrases. At any rate *Cleiothyris* can not be used as King intended.

The genus *Seminula* has hitherto been incorrectly used, with *Spirifer ambiguus* as type, on a doubtful identification of Davidson's—that *T. pentaëdra,* the true genotype, was a synonym of *S. ambiguus.* But *T. pentaëdra* is hypothyrid, that is, it has a rhynchonelliform beak; while *S. ambiguus* is epithyrid, that is, it has a terebratuliform beak. *T. pentaëdra* is what would at present be called a *Camarophoria. S. ambiguus* happens to have been taken as type of a genus *Composita* in 1845, but it has always been overlooked. Therefore—

Genus *Seminula,* McCoy.

Type *Terebratula pentaëdra,* Phillips.

Non *Seminula,* auct.

The genus is not of the family Athyridæ, but is a pentamerid, allied to the later named *Camarophoria,* which may, perhaps, be retained for the transverse multiplicate forms, *Seminula* designating the globose pauciplicate species.

Genus *Composita,* Brown.

Type *Spirifer ambiguus,* Sowerby.

Syn. *Seminula,* auct. non McCoy.

Ref. T. Brown, 'Illustr. Fossil Conch. G. Britain and Ireland,' p. 131, 1845. This work of Brown's has been altogether neglected, and his names overlooked; but he was quite definite about his type. His work appeared in parts from 1837 to 1849; and the date of p. 131 is 1845. (*Vide,* Sherborn, Proc. Malacol. Soc., VI., 358, 1905.) All the athyrids hitherto assigned to *Seminula* will have to bear the name *Composita.*

Genus *Leptodus,* Kayser.

Syn. *Lyttonia,* Waagen.

Leptodus is generally given as a synonym of *Lyttonia;* but Waagen was not justified in suppressing Kayser's name merely because he placed it among fishes.

Genus *Cyclothyris,* McCoy.

Type, the species figured by McCoy, 'Carb. Foss.,' p. 150, fig. 29 = *Terebratula latissima,* Sowerby.

Davidson made this suggestion, and it appears correct. Therefore, the bulk of the Mesozoic Rhynchonellæ—all those that are multiplicate and hypothyrid—should go under this genus rather than under *Rhynchonella,* which should be applied only to the species congruous with the *R. loxia* series of pauciplicate hypothyrids.

New names are required for *Hypothyris,* auct. non Phillips and *Cleiothyris,* auct. non Phillips. The following were suggested: *Hypothyridina,* vice *Hypothyris,* and *Cleiothyridina,* vice *Cleiothyris.*

S. S. BUCKMAN.

CURRENT NOTES ON METEOROLOGY.

THE CYCLONIC THEORY.

To the interesting discussion concerning temperatures in cyclones and anticyclones, H. H. Clayton contributes an article in the *Beiträge zur Physik der freien Atmosphäre,* Vol. II., No. 2, on 'A Discussion of the Observations obtained by the Blue Hill Observatory with Ballons-sondes at St. Louis.' As the readers of these notes are aware, this discussion has been going on for some time, and has been participated in chiefly by Hann, Clayton and Bigelow. To go into the details as each article appeared has always seemed to the compiler of these notes too technical a matter for the columns of a general scientific journal like SCIENCE, and to do so would have occupied a good deal more space than could be devoted to meteorology in this publication. We are glad to note the emphasis which Mr. Clayton lays upon the points upon which general agreement has been reached, for further discussion will be more helpful and more to the point if the matters which have found general acceptance are clearly established. To quote: "The results of all the investigators agree in showing that the highest temperatures at all heights within an area of low pressure are in advance of the barometric minimum and the lowest in the rear; while in the area of high pressure the lowest temperature is in advance of the barometric maximum and the highest

in the rear." This conclusion, Mr. Clayton believes, "will probably find general acceptance as representing the conditions up to 6 kms. everywhere in temperate latitudes." In answer to a criticism made by Hann (*Met. Zeitschr.*, Nov., 1905, 491) to the effect that Mr. Clayton had determined the central areas of cyclone and anticyclone from the time of high and low pressure at Blue Hill, and not from the weather maps, our author points out that the weather maps were used. We ourselves carelessly omitted to point out that Dr. Hann was mistaken in his objection, on the occasion of our mention of this matter in these notes some months ago.

CLIMATOLOGICAL ATLAS OF INDIA.

One of the most attractive, as well as one of the most important publications in climatology ever issued is the new 'Climatological Atlas of India,' prepared by Sir John Eliot, lately meteorological reporter to the government of India, and published by Bartholomew, of Edinburgh. This atlas contains one hundred and twenty colored maps, showing with great detail and in well-selected, harmonious colors, the distribution of the climatic elements over the Indian empire. We learn from the preface that a handbook of the weather and climates of India is in preparation and will be a companion volume to the atlas. India has for many years been well known for its admirable meteorological service and for its long series of valuable meteorological publications. Sir John Eliot has now fittingly ended his term of service as head of that organization by preparing this magnificent volume which will always stand as a monument to his work.

MONTHLY WEATHER REVIEW.

The last number of the *Monthly Weather Review* (No. 6, 1906) contains an illustrated paper by Professor J. E. Church, Jr., of the University of Nevada, on the new 'Mount Rose Weather Observatory,' in Nevada; a plea for the 'Use of the Lantern in Teaching Meteorology,' by Professor J. P. Goode, of the University of Chicago; a further instalment of his 'Studies on the Thermodynamics of the Atmosphere,' by Professor F. H. Bigelow; a description of a waterspout near Tarrytown, N. Y., July 16, 1904, illustrated by six half-tones; an account of 'The Tornado of June 6, 1906, near La Crosse, Wis.,' by G. A. Oberholzer, and of 'The Tornado of April 12, 1906, at Stafford, Kansas,' by W. E. Seright; and several short papers on 'The Structure of Hailstones.'

NOTES.

Professor W. I. Milham has published a 'Syllabus of a Course on Meteorology,' given by him in Williams College. The course is a three-hour elective for juniors and seniors, and is much more thorough than most of the courses at present being given in American colleges. Practical work in making observations, in generalizing from meteorological data and in making forecasts, is required as part of the course.

Ciel et Terre for September 1, 1906, contains articles on the dust from Vesuvius observed at Brussells last spring, and on atmospheric waves noted at the observatory of Meudon, by Millochau, by means of the telescope.

The Annual Report of the Transvaal Meteorological Department for the year ending June 30, 1905, contains several charts showing the distribution of the various meteorological elements; also half-tones of lightning views taken at Vereeniging in 1904–5.

R. DeC. Ward.

RECENT IMPORTANT ANTI-MALARIA WORK.

The latest reports on the measures taken to abolish malaria from Klang and Port Swettenham in Selangor, Federated Malay States, indicate the most admirable results. These measures were undertaken first in 1901 and 1902, and have been reported upon from time to time in the *Journal of Tropical Medicine*. The expenditure undertaken by the government with a view to improving the health of the inhabitants of these towns has been fully justified by the results which promise to be of permanent value. The total expenditure for the town of Klang, down to the end of 1905 was £3,100, and the annual permanent expenditure is about £60 for clearing earth

drains and £210 for town gardeners. For Port Swettenham the total expenditure to the end of 1905 was £7,000 and the annual cost of keeping up the drains, etc., is approximately £40 for clearing earth drains and £100 for town gardeners.

The careful tabulation of cases and deaths and of the results of the examination of blood of children in especially drained areas indicate the following conclusions: (1) Measures taken systematically to destroy breeding places of mosquitoes in these towns, the inhabitants of which suffered terribly from malaria, were followed almost immediately by a general improvement in health and decrease in death rate. (2) That this was due directly to the work carried out and not to a general dying out of malaria in the district, is clearly shown by figures pointing out that while malaria has practically ceased to exist in the areas treated it has actually increased to a considerable extent in other parts of the district where anti-malaria measures have not been undertaken.

The statistics for 1905 are even more favorable than those for 1902, which gives a very strong evidence in favor of the permanent nature of the improvement carried out. In fact, it seems as though malaria has been permanently stamped out at Klang and Port Swettenham by work undertaken in 1901, and this experience in the Malay States should be of value to those responsible for the health of communities similarly situated in many other parts of the world.

Another striking example of excellent work of this kind is found in the recently published report on the suppression of malaria in Ismailia, issued under the auspices of the Compagnie Universelle du Canal Maritime de Suez. Ismalia is now a town of 8,000 inhabitants. It was founded by DeLesseps in April, 1862, on the borders of Lake Timsah, which the Suez Canal crosses at mid-distance between the Red Sea and the Mediterranean. Malarial fever made its appearance in very severe form in September, 1877, although the city had up to that time been very healthy, and increased so that since 1886 almost all of the inhabitants have suffered from the fever. In 1901 an attempt to control the disease was made on the mosquito basis, and this attempt rapidly and completely succeeded, and after two years of work all traces of malaria disappeared from the city. The work was directed not only against anopheles mosquitoes, but against other culicids, and comprised the drainage of a large swamp and the other usual measures. The initial expense amounted to 50,000 francs, and the annual expenses since have amounted to about 18,300 francs.

The results may be summarized about as follows: Since the beginning of 1903 the ordinary mosquitoes have disappeared from Ismailia. Since the autumn of 1903 not a single larva of anopheles has been found in the protected zone, which extends to the west for a distance of one thousand meters from the first houses in the Arabian quarter and to the east for a distance of 1,800 meters from the first houses in the European quarter. After 1902 malarial fever obviously began to decrease, and since 1903 not a single new case of malaria has been found in Ismailia.

Last May Dr. Ronald Ross, of the Liverpool School of Tropical Medicine, to whom the writer is indebted for information concerning these instances just cited, was asked by the Lake Kopais Company in Greece to make a study of the malaria which has long been prevalent on their estates in that part of Greece. He made the trip and carried out the investigation which revealed an unexpectedly high degree of malarial infection in most of the localities examined. He also learned from members of the Grecian Anti-malaria League that the district of Kopais is by no means exceptional in this respect, and that malaria is very prevalent in many rural areas throughout the country.

As an example of the conditions, Dr. Ross found that in the village of Moulki, near the ancient Heliartos on the Kopaic Plain, of eighty persons examined, in thirty-eight there was an enlargement of the spleen—nearly fifty per cent.; at the village of Mazi he found it in thirteen cases out of forty; at Skripou (the ancient Orchomenos) it occurred in twenty-five out of fifty school children—exactly fifty per cent. He suggests the query as to how

far malaria has influenced the past history and the modern development of Greece, and shows that the regions maintaining most of the rural population are the ones most seriously affected—in fact, a vigorous country life can not exist under the conditions found. Where villages, churches, inns and country houses should be scattered about the landscape, the villages are few and poor and country houses are almost entirely absent.

The Antimalarial League of Greece, of which H. M. the King of Greece is patron, has already commenced work against malaria, and appeals for help to all those interested. The Liverpool School of Tropical Medicine has published an appeal for subscriptions, and H. R. H. Princess Christian has consented to be the patroness of the subscription in Great Britain. Subscriptions may be paid to the secretary of the Liverpool School of Tropical Medicine, B 10 Exchange Buildings, Liverpool, England.

So many excellent and most practical and convincing evidences of the possibility of the extermination of malaria are now culminating that it is obvious not only that with a certain expenditure of money the disease can be wiped out in a country like Greece, but that in our own territory the question is simply one of funds and an enlightened public spirit.

L. O. Howard.

THE CONVOCATION WEEK MEETINGS OF SCIENTIFIC SOCIETIES.

The American Association for the Advancement of Science and the national scientific societies named below will meet in New York City during convocation week, beginning on December 27, 1906.

American Association for the Advancement of Science.—December 27–January 1. Retiring president, Professor C. M. Woodward, Washington University, St. Louis, Mo.; president-elect, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, Dr. John F. Hayford, U. S. Coast and Geodetic Survey, Washington, D. C.; secretary of the council, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—J. J. Stevenson, chairman, C. C. Adams, Charles Baskerville, Franz Boas, N. L. Britton, H. C. Bumpus, Chas. A. Conant, Simon Flexner, Wm. J. Gies, Wm. Hallock, Alex. C. Humphreys, G. S. Huntington, Edward Kasner, Henry F. Osborn, C. L. Poor, Clifford Richardson, E. B. Wilson, Frederick J. E. Woodbridge, J. McKeen Cattell, secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor Edward Kasner, Columbia University; secretary, Professor L. G. Weld, University of Iowa, Iowa City, Iowa.

Section B, Physics.—Vice-president, Professor W. C. Sabine, Harvard University; secretary, Professor Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Section C, Chemistry.—Vice-president, Mr. Clifford Richardson, New York City; secretary, Professor Charles L. Parsons, New Hampshire College of Agriculture, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Mr. W. R. Warner, Cleveland, O.; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Dr. A. C. Lane, Lansing, Mich.; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York, N. Y.

Section F, Zoology.—Vice-president, Professor E. G. Conklin, University of Pennsylvania; secretary, Professor C. Judson Herrick, Denison University, Granville, Ohio.

Section G, Botany.—Vice-president Dr. D. T. MacDougal, Washington, D. C.; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology.—Vice-president, Professor Hugo Münsterberg, Harvard University; secretary, George H. Pepper, American Museum of Natural History.

Section I, Social and Economic Science.—Mr. Chas. A. Conant, New York City; secretary, Dr. J. F. Crowell, Bureau of Statistics, Washington, D. C.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Simon Flexner, The Rockefeller Institute for Medical Research; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor William James, Harvard University; secretary, Professor W. E. Castle, Harvard University.

The Astronomical and Astrophysical Society of America.—December 27. President, Professor E. C. Pickering, Harvard College Observatory; secre-

tary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wis.

The American Physical Society.—President, Professor Carl Barus, Brown University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Mathematical Society.—December 28, 29. President, Professor W. F. Osgood, Harvard University; secretary, Professor F. N. Cole, Columbia University.

The American Chemical Society.—December 27–January 2. President, Professor W. F. Hillebrand, U. S. Geological Survey; secretary, Dr. William A. Noyes, the Bureau of Standards, Washington, D. C.

The Geological Society of America.—December 26–29. Acting president, Professor W. M. Davis, Harvard University; secretary, Professor Herman L. Fairchild, Rochester, N. Y.

The Association of American Geographers.—December 31–January 1. President, Cyrus C. Adams, New York City; secretary, Albert P. Brigham, Colgate University.

The American Society of Zoologists.—December 27, 28, 29. President (Eastern Branch), Professor W. E. Castle, Harvard University; secretary, Professor H. S. Pratt, Haverford College. President (Central Branch), Professor C. C. Nutting, University of Iowa; secretary, Professor T. G. See, University of Michigan.

The Association of Economic Entomologists.—December 28, 29. President, A. H. Kirkland, Malden, Mass.; secretary, A. F. Burgess, Columbus, O.

The Society of American Bacteriologists.—President, Dr. E. F. Smith, U. S. Department of Agriculture; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—December 27, 28, 29. President, Professor W. H. Howell, the Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—December 27, 28, 29. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 333 East Ann St., Ann Arbor, Mich.

The Botanical Society of America.—December 27, 28, 29. President, Dr. F. S. Earle; secretary, Dr. William Trelease, Missouri Botanical Garden, St. Louis, Mo.

The American Psychological Association.—December 27–28. President, Professor James R. Angell, University of Chicago; secretary, Professor Wm. Harper Davis, Lehigh University.

The American Philosophical Association.—December 27–29. President, Professor William James, Harvard University; secretary, Professor John Grier Hibben, Princeton University.

The American Anthropological Association.—December 27–January 3. President, Professor F. W. Putnam, Harvard University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 27–January 3. President, Dr. A. L. Kroeber, University of California; secretary, W. W. Newell, Cambridge, Mass.

New York State Science Teachers Association.—December 26, 27. President, John F. Woodhull, Teachers College, Columbia University.

SCIENTIFIC NOTES AND NEWS.

DR. HENRY FAIRFIELD OSBORN, Da Costa professor of zoology in Columbia University, curator of vertebrate paleontology and vice-president of the American Museum of Natural History, geologist and paleontologist of the U. S. Geological Survey, has been elected secretary of the Smithsonian Institution to succeed the late Samuel Pierpont Langley.

THE Botanical Society of America (a union of the Botanical Society of America, the Society for Plant Morphology and Physiology and the American Mycological Society) will hold its first meeting, under the federation effected last winter, in New York City, during convocation week. The council will meet at 9 A.M. on Thursday, in Schermerhorn Hall, and a very important business session will be held in the same place at 11 o'clock the same morning. Scientific meetings will be held at Schermerhorn Hall on Friday afternoon, and at the Botanical Garden both morning and afternoon on Saturday. It is also possible that sessions may be held on the following Monday. Professor F. S. Earle, of Herradura, Cuba, is president and Dr. Wm. Trelease, of St. Louis, is secretary.

THE American Physiological Society will meet, as already announced, on December 27, 28, 29 in New York City. The meetings will be held on December 27 in the physiological laboratories of the University and Bellevue Hospital Medical College, 338 East 26th St.; on December 28 in the physiological laboratories of the College of Physicians and Surgeons, 437 West 59th St.; on December 29, joint meeting with Section K of the American Association for the Advancement of Science in the Rockefeller Institute for Medical Research, 66th St. and Avenue A. All communications should be addressed to the secretary,

Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

Emeritus Professor Campbell Fraser was presented on November 6, by the senatus and former pupils, with addresses of congratulation on the occasion of his jubilee as professor of logic and metaphysics in the University of Edinburgh. The principal, Sir William Turner, presided over a large representation of the senatus, and the class room was filled with the general public and students.

Dr. August Tobler, docent in paleontology at Basle, will make an expedition to the East Indies, lasting several years.

Dr. E. Grosse, associate professor of ethnology at Freiburg, has received leave of absence to carry on researches in east Asia.

The fourth lecture in the Harvey Society course was delivered by Professor J. G. Adami, of McGill University, Montreal, on December 1, at 8:30 P.M., at the New York Academy of Medicine. Subject: 'The Myelins and Potential Fluid Crystals of the Body.'

At its annual dinner, on November 21, the Society of Ex-Internes of Kings County Hospital, Brooklyn, presented to the hospital association a bronze memorial tablet in memory of the late Walter Reed, who was an interne there in 1871, prior to his entrance into the medical department of the United States Army.

A marble bust of Dr. Wilhelm Hittorf has been placed in the physical laboratory of Münster University, on the occasion of the celebration of the fiftieth anniversary of his doctorate.

Major Horatio N. Rust, noted both for his work on behalf of the Indians of southern California and for his archeological and ethnological collections and publications, died at South Pasadena, California, on November 14.

Dr. von Rothmund, professor of ophthalmology in the University of Munich, has died at the age of sixty-eight years.

The Rev. Dr. Johannes Dzierzon, known for his studies on bees, has died at the age of ninety-five years.

The U. S. Civil Service Commission announces the postponement, to January 3–4, 1907, of the examination scheduled for December 5–6, to fill at least four existing vacancies and vacancies as they may occur in the position of aid in the Coast and Geodetic Survey, at $720 per annum. A vacancy as computer at $1,400 to $1,800 per annum, according to experience, and one as draftsman, at $1,400 to $1,800, according to experience, both in the service of the Coast and Geodetic Survey at Manila, P. I., may also be filled from the eligibles resulting from this examination, provided suitable eligibles are secured. As the commission has experienced considerable difficulty in securing a sufficient number of eligibles for this position to meet the needs of the service, qualified persons are urged to enter this examination. There will also be a civil service examination on December 12, to fill a vacancy in the position of assistant in animal husbandry in the Bureau of Animal Industry, Department of Agriculture, at $1,800 per annum.

Among the New York State civil service examinations in December is one of chemist in the Department of Agriculture at a salary of $1,200. The examination will have special reference to the analysis of food and dairy products.

A Seismological Society has been formed in California. The letter calling a preliminary meeting says: "The formation of such a society would seem to be both proper and opportune. The fact that the Pacific coast has been the center of much seismic activity, and that the city of San Francisco has now a historic interest in matters seismological, may be offered as valid reasons why this section of our country should take the initiative in the formation of such an organization. The State Earthquake Commission is on record as favoring the formation of a seismological society. Several earnest investigators, including Dr. Omori, who recently visited the coast, have urged that organized effort be attempted through such a society, to collect, preserve and utilize all records, reports and studies of seismic phenomena. The prime object of such an organization as in Japan should be to

mold public opinion, to advise wisely, to set forth the truth and to provide funds for research and investigation. It is expected that such a society will be able, with the funds entrusted to its care, to publish from time to time the best information obtainable concerning earthquakes, and in every way work for the benefit and welfare of not only our own community but all mankind, so far as the effects of earth movements are concerned."

THE second meeting of the Southern Society for Philosophy and Psychology will be held in Montgomery, Alabama, in connection with the Southern Educational Association, December 27–29. Further particulars will be given later.

MR. LESTER F. WARD would be glad to be informed of as many as possible of the native plants, especially trees and shrubs, of the country which possess the sympodial type of branching, either complete or partial. Names, lists, notes, etc., may be sent to him at Brown University, Providence, R. I. Observations of sufficient importance might be sent to SCIENCE for publication. Any estimates of the proportion of sympodial to monopodial plants would be of interest. The subject is a neglected one, and references to the best treatment of it would be useful.

IN an interesting and well-written article on 'The Lure of the Pearl' in the November *Century*, Mr. Frederick Courtland Penfield has this amusing bit of zoology: "It should be known that the pearl-bearing oyster of the Indian Ocean is only remotely related to the edible variety of America and Europe. It is the *Margaritifera vulgaris*, said to belong to the animal kingdom, and not to the fish family, and is never eaten."

WE learn from *The Journal of Experiment Stations* that the Chinese government has approved a request made by the native board of commerce at Peking for the use of the Loshan garden, which is situated on the Imperial Road outside of the Hsichih Gate of Peking, with an area of 166⅔ acres, as a field for agricultural experiments. In 1905 the board was authorized to take measures for the encouragement of agriculture, but up to the present, with the exception of the few experimental fields and agricultural schools established in Chihli, Shantung, Shansi, Honan and Fukien, little has been done along this line.

THE *Journal of the American Medical Association* states that the Berlin Academy of Sciences has been examining the rich material of ancient medical MSS. in its library, and has just published the first volume of a descriptive catalogue, devoted to works dealing with Hippocrates and Galen. The work has been in charge of Professors H. Diels and G. Schöne. After the complete catalogue is issued it is proposed to publish all the MSS. in full. Professor Heiberg, of Copenhagen, is to help in this task, especially with the Egyptian papyri.

THE Medical Relief Committee, representing the New York Academy of Medicine, and the Medical Societies of the counties of New York and Richmond, announces that the total sum transmitted to the Medical Relief Committee at San Francisco amounted to $7,701.10.

THE daily papers state that 'broadly speaking, the northern hemisphere will after November 1 report daily on its weather conditions to the Weather Bureau in Washington.' An arrangement made with the Central Physical Observatory at St. Petersburg enables reports to be received from the great land area lying between the Russian capital and the Pacific, while the opening of cable communication with Iceland will render possible telegraphic reports of the area of low winter barometer of the North Atlantic. As a consequence of these additional services, it is hoped that the bureau will be in a position to deal with world conditions and to make accurate forecasts for a longer time than ever before.

WE learn from *Nature* that the board of directors of the great manufacturing firm of Kynoch (Ltd.) has decided to introduce the metric system of weights and measures into all their works. A small committee has been appointed to consider the details of the change and to provide the necessary instruments, and

as soon as the committee reports the change will be made. All the weights and measures used by the firm, whether lineal, square or cubic, will be metric. For money calculations the pound sterling will be adopted as the unit, and this will be subdivided decimally.

The Wisconsin Natural History Society announces the following series of nine public lectures to be given during the season of 1906–7 at the Public Museum, Milwaukee. This society is one of the oldest of its kind in the west, having been founded in 1857. At the May meeting the fiftieth anniversary of its foundation will be celebrated.

October 25.—Dr. R. M. Strong, University of Chicago, 'Colors of Birds.' (Illustrated by stereopticon.)

November 22.—Dr. E. C. Case, Wisconsin State Normal School, 'Geological Development of Scenery.' (Illustrated by stereopticon.)

December 20.—Professor C. O. Whitman, University of Chicago, 'The Origin of Species.' (Illustrated by charts.)

January 31.—C. T. Brues, Milwaukee Public Museum, 'The Rôle Played by Insects in the Transmission of Certain Diseases of Man and the Higher Animals.' (Illustrated by stereopticon.)

February 28.—Professor S. W. Williston, The University of Chicago, 'The Phylogeny of the Elephant.' (Illustrated by stereopticon.)

March 28.—Dr. S. Graenicher, Milwaukee, 'The Adaptive Coloration of Insects.' (Illustrated by steropticon.)

April 25.—H. L. Ward, Milwaukee Public Museum, 'Museum Collecting.' (Illustrated by stereopticon.)

May 30.—The Fiftieth Anniversary of the Founding of the Society.—C. H. Doerflinger will give a brief sketch of the founding of the society, followed by Professor E. A. Birge, The University of Wisconsin, 'Science and the People.'

June 27.—I. N. Mitchell, Wisconsin State Normal School, 'Burbank's Work with Plants.' (Illustrated by stereopticon.)

Professor A. R. Crook, curator of the Illinois State Museum of Natural History, announces that a course of popular lectures on natural history and travel will be given in the Arsenal Auditorium on Saturday evenings at eight o'clock as follows:

December 1.—A. R. Crook, Ph.D., Curator, Illinois State Museum of Natural History, 'The Making of the Grand Canyon of the Colorado.' (Illustrated.)

December 8.—O. C. Farrington, Ph.D., Curator of Geology, Field Columbian Museum, 'American Caverns.' (Illustrated.)

December 15.—H. G. Keppel, Ph.D., Northwestern University, 'Holland and the Hollanders.' (Illustrated.)

January 12.—Chas. F. Millspaugh, Ph.D., Curator of Botany, Field Columbian Museum, 'Japan Resourceful.' (Illustrated.)

January 19.—Professor S. W. Parr, University of Illinois, 'What is Coal?' (Illustrated.)

January 26.—H. Foster Bain, Ph.D., State Geologist, 'Origin of Fuels.'

The Educational Times states that an important international inquiry into the methods and results of moral training in schools at home and abroad has been initiated in London. It is proposed to institute an inquiry, conducted by trained investigators, who will visit many European countries, the United States and Japan, to ascertain the conclusions which the best authorities in the different countries have reached as the outcome of their recent efforts. It is hoped to complete this inquiry and to publish the reports of the investigators by the autumn of 1907. The committee, which it is desired to strengthen by the admission of many more distinguished names, already includes, among others, the Bishops of Ripon, Hereford and Stepney, Sir Edward Fry the Right Hon. A. Dyke Acland, former minister of education, Sir Oliver Lodge, the Rev. J. B. Paton, D.D. (of Nottingham), Mr. Harrold Johnson, Secretary of the Moral Instruction League and Professor M. E. Sadler, LL.D., who is acting as hon. secretary at 8 Buckingham Street, Strand, W. C.

The Copenhagen correspondent of the *Medical Record* writes: "Dr. Schaldemose will be appointed successor to Professor Wanscher, who died six months ago. The competition has been very close, not less than eight of our most prominent younger surgeons having entered it. Each competitor had to publish a work of no small size on a surgical topic of his own choosing and to deliver a clinical lecture with three hours' preparation. Three of the competitors, Drs. P. N. Hansen, Lendorf, and Schaldemose, were then admitted to the

final trials, consisting in a lecture on a surgical theme, the same for all of them, and communicated to them twenty-four hours in advance. It is generally reported that the judges found it very difficult to decide which of the three mentioned surgeons was most qualified to succeed to the disputed chair."

ACCORDING to *Nature* the promise of an interesting and useful addition to the local museums in the London district has been furnished by the spirited action of the Tottenham Local Board. In 1892 the Board purchased the fine 'Queen Anne' mansion known as Bruce Castle from Mr. Joshua Pedley at the price he had given for it, 15,000*l.*, toward which sum he contributed 700*l.*, in the hope that some day the house would become the home of a museum for Tottenham. The estate included twenty acres of garden and timbered land, which was soon thrown open as a public park. The idea of a museum having been grasped, many specimens and offers of aid came in from neighbors and friends. By gift, and as a result of a public subscription, several important collections were acquired. Especially worthy of mention are the long series of birds, small mammals and insects in cases and cabinets, made by Mr. H. W. Roberts, formerly a resident in Tottenham; a collection of minerals and fossils formed by Mr. Penstone, a friend of John Ruskin; and the collections of fossils and wax models made and lent by Mr. H. E. H. Smedley. Mr. Smedley is acting as honorary curator, and has generously devoted much time and skill to getting the collections into a fit state for public exhibition. Other important gifts have been made by Mr. C. C. Knight, the Hon. Walter Rothschild, Mr. Ruck, Mr. Currie, and others. The museum was publicly opened by Mr. W. W. Lewin, chairman of the libraries committee, and Councillor Knight on October 26. Mr. Smedley is responsible for the scheme of the museum, which will embrace a purely local collection of Middlesex natural history and illustrations of ancient Tottenham, while the educational aspect will be kept well in view, including exhibitions of living animals and plants designed to encourage observation at first-hand in the field.

THE *Scottish Geographical Magazine* has received from Dr. J. P. Thomson some particulars of a great irrigation scheme which the New South Wales government proposes to carry out in the Murrumbidgee Valley and the Lachlan, Namoi, and Gwydor basins. The first work which it is proposed to undertake is the construction of a dam and reservoir at Barren Jack. Barren Jack is about thirty miles from Bowning Railway Station on the Sydney to Melbourne line. The site is a deep gorge, where the river has cut through a solid ridge of granite. The sides of the gorge are between 300 feet and 400 feet high. The proposal embraces constructing a wall 200 feet in height right across the Murrumbidgee, thus damming the waters back for a distance of 40 miles. The reservoir will contain one and a half time more water than Sydney Harbor, and, in fact, will be little inferior to the great Nile dam. Much of the area of the actual dam site is now under cultivation as agricultural farms, and these will all have to be resumed. The full capacity of the reservoir will be 33,380,864,000 cubic feet, and the cost of the dam, including resumption of lands, is £758,000. The dam will first be built to a height of 120 feet, and its full height will be reached, it is anticipated, in seven years from the date of its commencement. The catchment area is 5,000 square miles, embracing the whole of the country drained by the headwaters of the Murrumbidgee. One great feature of this scheme is that the waters will be brought to the land irrigated entirely by gravitation, and pumping will not be necessary. The new dam when constructed will be one of the greatest sights in the commonwealth, and the New South Wales government have selected a proposed site for the Federal capital right in its immediate neighborhood. This site is known as Makoolma. Two or three alternative lines for a light railway have been surveyed to connect Bowning with the dam.

THE total value of the stone produced in the United States during 1905, according to a forthcoming report of the United States Geological Survey, was $63,798,748. This total includes granite at $17,563,139, trap rock at $3,074,554, sandstone, not including grind-

stones and whetstones, at $8,075,149, bluestone at $1,931,625, marble at $7,129,071, and limestone at $26,025,210. As the corresponding value for 1904 was $58,765,715, it appears that the production showed a gain of $5,033,033 during 1905. The increased output for 1905 was caused by more activity in the building trades, and chiefly by a large increase in the output of limestone for use as furnace flux, which the reopening of many iron furnaces demanded. Granite, marble and limestone increased in value of output, while sandstone decreased slightly. Limestone showed the largest increase, from $22,178,964 in 1904 to $26,025,210 in 1905, or $3,846,246. Granite, including trap rock, gneiss, basalt, etc., increased in value from $20,015,025 in 1904 to $20,637,693 in 1905, a gain of $622,668. The trap rock increased in value from $2,823,546 in 1904 to $3,074,554 in 1905, or $251,008. Other granite increased in value from $17,191,479 in 1904 to $17,563,139 in 1905, a gain of $371,660. Marble increased in value from $6,297,835 in 1904 to $7,129,071 in 1905, a gain of $831,236. Sandstone, including bluestone, decreased in value from $10,273,891 in 1904 to $10,006,774 in 1905, a loss of $267,117. Bluestone increased in value from $1,791,729 in 1904 to $1,931,625 in 1905, a gain of $139,896. The sandstone figures showed a decrease in value of $407,013—from $8,482,162 in 1904 to $8,075,149 in 1905. The production of these different kinds of stone by individual states is set forth in detail in this report, which was prepared by Miss A. T. Coons, under the direction of Mr. Edwin C. Eckel.

UNIVERSITY AND EDUCATIONAL NEWS.

The General Education Board held a meeting last week when Acting-president Henry Pratt Judson, of the University of Chicago; President E. A. Alderman, of the University of Virginia, and President H. B. Frisell, of the Hampton Institute, were elected trustees. The following grants were made:

Drury College, Springfield, Mo.	$ 50,000
Iowa College, Grinnell, Iowa	100,000
Richmond College, Richmond, Va.	150,000
Lawrence University, Appleton, Wis.	50,000
Washington and Lee University, Lexington, Va.	5,000
Mercer University, Macon, Ga.	75,000
Randolph-Macon College, Ashland, Va.	100,000

The gifts made within the last six months, in addition to those already mentioned, are:

Tulane University, New Orleans	$75,000
Washburn College, Topeka, Kan.	25,000
Coe College, Cedar Rapids, Iowa	50,000
Wofford College, Spartansburg, S. C.	35,000
Furman University, Greenville, S. C.	25,000
Wake Forest College, Wake Forest, S. C.	37,500
Howard College, Birmingham, Ala.	25,000
Mississippi College, Clinton, Mass.	25,000
Southwestern University, Jackson, Tenn.	25,000

We understand that the institutions are required to raise three times the amount of the appropriation from the board.

The daily papers state that Mr. Andrew Carnegie has founded a scholarship in physics at the University of Paris with the sum of $2,500, in honor of the late Professor Curie and Mme. Curie.

Sir J. T. Brunner has endowed a chair of Egyptology in the University of Liverpool.

A new laboratory for experimental physics is in course of erection at the University of Toronto. The building is planned on the unit system and will cost when completed, with equipment, approximately $350,000. The laboratory is designed to accommodate the students in physics of the faculties of arts, medicine and applied science, which at the present time number about eight hundred.

The John C. Green School of Science at Princeton University has this year a larger enrollment than the academic department. The numbers in each class are: senior, 78; junior, 67; sophomore, 144; freshman, 183. The registration in the academic department is: senior, 207; junior, 181; sophomore, 167; freshman, 139.

Dr. H. E. Annett has been elected to a newly established chair of comparative pathology in the University of Liverpool.

Dr. Emil Philippi, docent in Berlin, has been elected to the Haeckel chair of geology and paleontology in the University of Jena.

Dr. Otto Jaeckel, curator in the Berlin Museum, has been called to a chair of geology at Greifswald.